Research Product 91-13

Task Analysis for the Combat Vehicle Command and Control (CVCC) System

June 1991

Fort Knox Field Unit
Training Research Laboratory

U.S. Army Research Institute for the Behavioral and Social Sciences

U.S. ARMY RESEARCH INSTITUTE
FOR THE BEHAVIORAL AND SOCIAL SCIENCES

A Field Operating Agency Under the Jurisdiction of the Deputy Chief of Staff for Personnel

EDGAR M. JOHNSON
Technical Director

JON W. BLADES
COL, IN
Commanding

Research accomplished under contract for
the Department of the Army

Dynamics Research Corporation

Technical review by

Ronald E. Kraemer
Bruce W. Knerr

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION Unclassified	1b. RESTRICTIVE MARKINGS --
2a. SECURITY CLASSIFICATION AUTHORITY --	3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution is unlimited.
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE --	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) E-16879U	5. MONITORING ORGANIZATION REPORT NUMBER(S) ARI Research Product 91-13
6a. NAME OF PERFORMING ORGANIZATION Dynamics Research Corporation 6b. OFFICE SYMBOL (If applicable) --	7a. NAME OF MONITORING ORGANIZATION U.S. Army Research Institute Field Unit at Fort Knox
6c. ADDRESS (City, State, and ZIP Code) 60 Concord Street Wilmington, MA 01887	7b. ADDRESS (City, State, and ZIP Code) ATTN: PERI-IK Fort Knox, KY 40121-5620
8a. NAME OF FUNDING/SPONSORING ORGANIZATION U.S. Army Research Institute for the Behavioral and Social Sciences 8b. OFFICE SYMBOL (If applicable) PERI-I	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER DAHC35-89-C-0047
8c. ADDRESS (City, State, and ZIP Code) 5001 Eisenhower Avenue Alexandria, VA 22333-5600	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. 63007A; PROJECT NO. 795; TASK NO. 3101; WORK UNIT ACCESSION NO. C4

11. TITLE (Include Security Classification)
Task Analysis for the Combat Vehicle Command and Control (CVCC) System

12. PERSONAL AUTHOR(S)
Wigginton, Donald; and O'Brien, Lawrence H.

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
Final	FROM 89/10 TO 91/01	1991, June	124

16. SUPPLEMENTARY NOTATION
Kathleen Quinkert, Contracting Officer's Representative

17. COSATI CODES		
FIELD	GROUP	SUB-GROUP

18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
Combat Vehicle Command and Control System (CVCC)
Task analysis,
Close Combat Test Bed (CCTB), → (Continued)

19. ABSTRACT (Continue on reverse if necessary and identify by block number)
This research product describes the results of a task analysis conducted to support research efforts on the Combat Vehicle Command and Control (CVCC) system. The CVCC is a set of selected futuristic components with functions simulated in the Close Combat Test Bed (CCTB) environment. The objective of the task analysis was to provide the minimum essential task information needed to support (a) the early assessment of CVCC training requirements, and (b) the development of simulation models of CVCC operator task performance.

(25) * Combat vehicle, * Command and Control Systems,

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT	21. ABSTRACT SECURITY CLASSIFICATION
☑ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS	Unclassified
22a. NAME OF RESPONSIBLE INDIVIDUAL Kathleen Quinkert	22b. TELEPHONE (Include Area Code) (502) 624-6928 22c. OFFICE SYMBOL PERI-IK

DD Form 1473, JUN 86 Previous editions are obsolete.

SECURITY CLASSIFICATION OF THIS PAGE
UNCLASSIFIED

ARI Research Product 91-13

18. SUBJECT TERMS (Continued)

M-1 tanks,
~~M1 tank~~
Command control, communication (C3)
Simulators

Accession For	
NTIS GRA&I	☑
DTIC TAB	☐
Unannounced	☐
Justification	
By	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
A-1	

Research Product 91-13

Task Analysis for the Combat Vehicle Command and Control (CVCC) System

Donald Wigginton and Lawrence H. O'Brien
Dynamics Research Corporation

Field Unit at Fort Knox, Kentucky
Donald F. Haggard, Chief

Training Research Laboratory
Jack H. Hiller, Director

U.S. Army Research Institute for the Behavioral and Social Sciences
5001 Eisenhower Avenue, Alexandria, Virginia 22333-5600

Office, Deputy Chief of Staff for Personnel
Department of the Army

June 1991

Army Project Number
2Q263007A795

Training Simulation

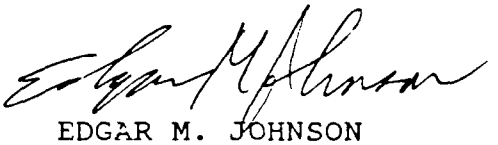
FOREWORD

The U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) provides research, development, and applications support to ensure that soldier-related issues are considered in the weapon system acquisition process. The Future Battlefield Conditions team of the ARI Field Unit at Fort Knox performs research on soldier performance and training issues by using simulation-based evaluations to investigate concepts and early training requirements analyses of future systems such as those for command, control, and communication (C^3).

This research product was prepared under science and technology task 3101, "Training Requirements for the Future Integrated Battlefield." ARI's research on future battlefield conditions supports two Memoranda of Understanding. One is between ARI and the U.S. Army Armor Center and School on research in future battlefield conditions, signed on 12 April 1989. The second is between ARI and the Tank Automotive Command (TACOM) on the Combat Vehicle Command and Control (CCVC) System, signed on 22 March 1989.

ARI has briefed the CVCC research and development program to the Commanding General, U.S. Army Armor Center and School, the U.S. Army Armor School's Directors of Combat Developments and Training and Doctrine, representatives from the Tank Automotive Command, Project Manager Training Devices, and the Training and Doctrine Command System Manager, SIMNET.

This product identifies CVCC-related tasks and presents task analysis information useful for two purposes. The first is to support early training requirements analysis for the functions associated with the CVCC. The second purpose is to identify essential tasks required for development of simulation models of CVCC operator task performance. The task analysis consists of both task data elements and flow diagrams of task elements within the task. The task analysis was verified on functional representations of the CVCC incorporated into the Close Combat Test Bed (CCTB), formerly referred to as SIMNET-D, at Fort Knox.



EDGAR M. JOHNSON
Technical Director

TASK ANALYSIS FOR THE COMBAT VEHICLE COMMAND AND CONTROL (CVCC) SYSTEM

CONTENTS

LIST OF TABLES

CONTENTS (Continued)

LIST OF FIGURES

TASK ANALYSIS FOR THE COMBAT VEHICLE COMMAND AND CONTROL (CVCC) SYSTEM

1.0 Objective

This research product describes the results of a task analysis conducted in support of the U.S. Army Research Institute Fort Knox Field Unit's research efforts on the Combat Vehicle Command and Control (CVCC) system. The CVCC is a set of futuristic Command, Control and Communication (C^3) components whose functions are simulated in the Close Combat Test Bed (CCTB), formerly Simulation Networking-Developmental (SIMNET-D) developed by the Defense Advanced Research Projects Agency (DARPA). The objective of the task analysis was to provide the minimum essential task information needed to support (a) the early assessment of CVCC training requirements, and (b) the development of simulation models of CVCC operator task performance.

2.0 Background

The CVCC task analysis was part of a larger effort to evaluate the impact of the CVCC on tank commander performance at the company level and below. In addition to the CVCC, the company-level evaluation included the current M1 that served as the baseline comparison. During the evaluation, functional representations of the CVCC were generated using the CCTB facilities at Fort Knox. Soldiers used these systems in a series of realistic mission exercises. During the exercises, workload and performance data were collected.

The CVCC company evaluation had three major objectives: (a) to evaluate the operational effectiveness of armor companies using a tactical C^3 concept configuration, (b) to identify critical soldier-machine interface (SMI) issues associated with the use of the concept configuration and make recommendations concerning system design, and (c) to determine operational training requirements, issues, and concerns for the new system. The evaluation produced three major products:

1. An assessment of the impact of the CVCC on key unit performance measures (Leibrecht et al., in preparation)

2. An assessment of the workload impacts of the CVCC (Morey, Wigginton, & O'Brien, in preparation).

3. A User Guide describing a methodology that can be used to assess performance and workload in future CCTB studies (O'Brien, Morey, & Wigginton, in preparation)

Task analysis is a central feature of the Army's Systems Approach to Training [TRADOC Pamphlet 351-13 (Draft), July, 1990] and is required for all new system developments (Department of Defense, 1979). Meister (1985) provides four purposes for performing a task analysis:

> To assist in (1) the design of the system, meaning the man-machine interface, the total job, construction of procedures, job aids, etc., (2) the manning of the system, meaning the development of the selection criteria and determination of the number and type of personnel needed, (3) the development of an instructional system, meaning the development of the curriculum, selection of critical tasks to be trained, etc., and (4) the evaluation of the completed system, by establishing performance criteria against which system personnel performance can be measured. (p. 32)

System design, training, and evaluation draw on the comprehensive task analysis conducted early in the life cycle of the proposed system. With respect to training, decisions regarding new system designs and how functions are allocated between the system and its users have impacts on the training requirements for both users and maintainers. Early estimation of these training impacts, mandated by current Department of Defense directives, provides valuable inputs to the design process. Recent developments in analytical tools and automated aids for assessing these training requirements use comparability analysis as the principal method to estimate task requirements for developmental systems (Jorgensen and O'Brien, 1983). In this approach, existing systems similar to the developing system in function or capability are identified. Task data for the comparable system(s) are then collected and modified to reflect the differences in design or usage between the new and comparable system. Tasks are then rated on various criteria to determine the subset of tasks having training requirements. This list provides the basis for preliminary estimates of training program estimation (e.g., training media selection) and training resource requirements such as (a) the number of students to be trained, (b) the number of instructors and support personnel required, (c) facilities requirements, and (d) training device and training equipment requirements.

CCTB offers an alternative to comparability analysis for conducting this early training requirements analysis. Functional representations of the proposed system can be integrated into the CCTB environment. The impacts on existing user tasks or the need

for new tasks can be identified and assessed through hands-on developmental evaluations.

2.1 Overview of CCTB

CCTB refers to simulation capabilities developed under the DARPA SIMNET program. The objective of the SIMNET program was to develop a technology base for low-cost, full-crew combat system simulators. SIMNET-D utilized this technology to provide an advanced testbed for evaluating new technologies and tactics for combat weapon systems (Miller and Chung, 1987). The original SIMNET-D facility, now referred to as CCTB, includes a set of reconfigurable simulators, an advanced capability for modeling threat and friendly forces, as well as extensive capabilities for data collection and display. A more detailed description of CCTB is found in DuBois (1989) and Gound & Schwab (1988).

The CVCC system was created from functional specifications developed by the Army Research Institute in cooperation with the Tank Automative Command (TACOM). The CVCC components integrated into the CCTB provided the primary source of information for the CVCC task analysis.

2.2 Overview of CVCC Subsystems

To represent the expected capabilities of the CVCC, four major subsystems (Position Navigation System, Command and Control Display, Commanders Independent Thermal Viewer, and Single Channel Ground Radio System) were added to M1 simulators in the CCTB facility. These four subsystems provided tank commanders with the following capabilities [see Appendix A for a more detailed description as found in Ainslie, Leibrecht, & Atwood (in preparation)].

Position Navigation (POSNAV) System -- Automatically identified the position of the tank on the battlefield in xy grid coordinates.

Command and Control Display (CCD) -- Provided a capability for generating and displaying digital maps. These maps could display the position of all tanks in the unit as well as other objects (e.g., threats, waypoints, objectives) which had been entered in the tank's digital data base either directly by the tank commander or by the tank's other digital systems (e.g., SINCGARS). The simulated SINCGARS link allowed information generated by other tanks and the unit operations center to be transmitted and then added directly to the digital data bases of other tanks.

The CCD provided a capability for generating digital versions of the most common tank commander reports. These reports supported

the incorporation of location information based on integration of data from other tank subsystems (e.g., the LRF and POSNAV).

The tank commander could also enter directions for reaching the next waypoint (heading, distance) that were directly transmitted to and presented on the driver's steer-to display.

Commander's Independent Thermal Viewer (CITV) -- Provided the tank commander with his own thermal viewer. This viewer could be pointed in a direction that was completely independent of the main gun (i.e., the gunner's primary sight). The CITV software had algorithms which could automatically identify targets. This software also allowed the commander to prioritize multiple target locations. The priority number of each target location was displayed to the gunner. The gunner could then select a target priority and the main gun would automatically slew to that location.

Single Channel Ground and Air Radio System (SINCGARS) -- Provided a capability for transmitting digital information between tanks and the unit operations center. For example, using SINCGARS, information on the current tank's positions from POSNAV could automatically be sent to all other tanks in the unit.

3.0 Task Analysis Methodology

3.1 Identification of Tasks to be Analyzed

The focus of the task analysis was on (a) new tasks required to operate the CVCC or (b) current tasks significantly modified by the CVCC functions. New tasks were additional tasks, beyond those performed on the current M1, required to operate the CVCC system. A variety of sources, such as the Soldier Training Publications, describe the tasks associated with the current M1 system. Task listings in these sources were reviewed to identify the specific tasks likely to be associated with CVCC operation. Table 3-1 lists the tasks that were generated by this process. Table 3-2 lists the relationship between the CVCC tasks and existing task descriptions. Section 3.4 lists the data sources.

3.2 Information Elements Identified in the Task Analysis

The primary goal of the task analysis was to identify the minimum essential elements of information needed to support an "early" assessment of training requirements for the CVCC. Since only a functional representation of the CVCC was evaluated, implementation of a detailed task analysis as specified in Army training development procedures (i.e., TRADOC Form 550) was not warranted.

Table 3-1

CVCC User Task List

CVCC Task Number	Task Title
1	Receive and Review Report Using CCD
2	Prepare and Submit Spot Report Using CCD
3	Prepare and Submit Shell Report Using CCD
4	Prepare and Submit Contact Report Using CCD
5	Prepare and Submit Call For Fire Report Using CCD
6	Prepare and Submit SITREP Report Using CCD
7	Prepare and Submit NBC Report Using CCD
8	Designate and Transmit Route Coordinates Using CCD
9	Receive and Review Route Coordinates Using CCD
10	Prepare and Submit Adjust Fire Report Using CCD
11	Prepare and Submit Ammunition Report Using CCD
12	Prepare and Submit Intelligence Report Using CCD
13	Receive, Review, and Retransmit FRAGO Report Using CCD
14	Search for Targets Using the CITV
15	Identify and Prioritize Targets Using the CITV
16	Control Map Display Functions Using CCD

Table 3-2

Relationships Between CVCC Tasks and Existing Tasks

TASK NO.	TASK TITLE	TASK REFERENCE	CVCC TASK
01-1240.00-0007	Select Movement Route Based on the Military Aspects of Terrain	STP 17-12II-MQS	13, 16
03-3120.00-0002	Analyze Terrain Using the Five Aspects of Terrain	STP 17-12II-MQS	13, 16
03-3060.00-6005	Prepare/Submit Standard Shelling, Mortaring, and Bombing Report	STP 21-II/III-M	2-6
031-503-3005	Prepare/Submit NBC-1 Report	STP 21-24-SMCT	7
031-503-4004	Prepare/Submit NBC-4 Report	STP 21-24-SMCT	7
113-571-1003	Establish, Enter, or Leave a Radio Net	STP 17-19K1-SM	8, 9
113-622-2004	Operate Radio Set Control Op AN/GRA 39	STP 17-19K1-SM	8, 9
113-622-2011	Operate Intercommunication Set AN/VIC-1 on a Tracked Vehicle (Includes FM Radio)	STP 17-19D1-SM	8, 9
01-5704.03-0900	Prepare/Operate AN/VRC-12 Series Radio	STP 17-12II-MQS	8, 9
071-326-5502	Issue a Platoon Fragmentary Order (FRAGO)	STP 17-19D1-SM	16
071-326-5626	Prepare and Issue an Oral Operational order (OPORD)	STP 17-19K24-SM	16
01-1241.00-0001	Conduct Fire and Movement of a Unit at Platoon Level	STP 17-12II/MQS	11, 12

Table 3-2 (cont'd)

TASK NO.	TASK TITLE	TASK REFERENCE	CVCC TASK
01-1225.00-0001	Determine the Range to a Target Using the Immediate or Deliberate Method	STP 17-12II-MQS	14, 15
No task number	Determine Range to Target Using Laser Rangefinder	PDEP 9-2350-264-10-1	14, 15
171-123-1041 171-129-1020	Issue a Fire Command	STP 17-19E1-SM FM 17-12-1	12
171-126-1002	Drive an M1/M1A1 tank	STP 17-19K1-SM	11
171-126-1001	Start/Stop the Engine on an M1/M1A1 Tank	STP 17-19K1-SM	11

Note: TASK NO. is the task identification number found in the Task Reference. There are numerous tasks (17) referenced in the STP 17-12II-MQS that are related to land navigation.

In addition to the early identification of training requirements, the task analysis was also designed to identify the descriptive information needed to support the development of the simulation models of CVCC operators. Simulation models can be developed using analytical tools such as MicroSaint that indicate operator overload, and provide overall time and performance estimates based on system design changes or alternative performance strategies.

Table 3-3 displays the information elements that were selected for inclusion in the task analysis. Table 3-3 also indicates the reason that each of these elements was selected for inclusion in the analysis (i.e., either to support early training requirements analysis or to support the simulation model development). The training-related elements were chosen by selecting a subset of the information elements used in traditional Army task analyses (i.e., TRADOC Form 550). The model-related elements were selected to meet the unique needs to the CVCC tank commander simulation models (see O'Brien, Morey, & Wigginton, in preparation).

A detailed definition of each element in Table 3-3 is provided in Section 4.

3.3 Tools for Documenting Task Analysis

Three tools were selected to record and document the information collected during the task analysis. First, a microcomputer-based data base management system (dBASE III PLUS) recorded the textual information that was used to describe most of the task analysis information elements. Figure 3-1 provides an overview of the structure of this data base. Appendix B provides a complete listing of all the information in the data base.

Second, a microcomputer-based flow chart program was used to describe the sequencing of task elements within a task. Figure 3-2 provides an example of one of the flow charts that was produced with this program. The flow charts for all of the CVCC tasks are listed in Appendix C.

Third, using video recording capabilities already present in CCTB, a video tape of potential task element sequences was made. In these videos, researchers demonstrated how CVCC control and displays were used in performing each task element.

3.4 Data Sources

The primary data source for obtaining information on current tank commander tasks was the soldier training publications for Military Occupation Specialty (MOS) 19K and Military Qualification Standards (MQS) for armor officers. The MOS 19K identifies enlisted soldiers who serve as M1 tank crewmen (tank commander, driver, gunner, or loader). The MQS for Level 11 Armor Officer

Table 3-3

Task Analysis Data Elements

DATA ELEMENT	DATA ELEMENT INCLUDED TO SUPPORT		PRIMARY METHOD OF DOCUMENTATION
	TRAINING	SIMULATION MODEL	
Duty Position	X	X	Textual Data base
Conditions of Performance	X		Textual Data base
Performance Measures	X	X	Textual Data base
Initiating Cues	X	X	Textual Data base
Terminating Cues	X	X	Textual Data base
Feedback Cues	X	X	Textual Data base
Frequency	X		Textual Data base
Criticality	X		Textual Data base
Learning Difficulty	X		Textual Data base
Skills and Knowledge	X		Textual Data base
Task Elements	X	X	Textual Data base
Displays	X	X	Textual Data base
Controls	X	X	Textual Data base
Performance Time	X	X	Textual Data base
Task Element Sequencing	X	X	Flow chart

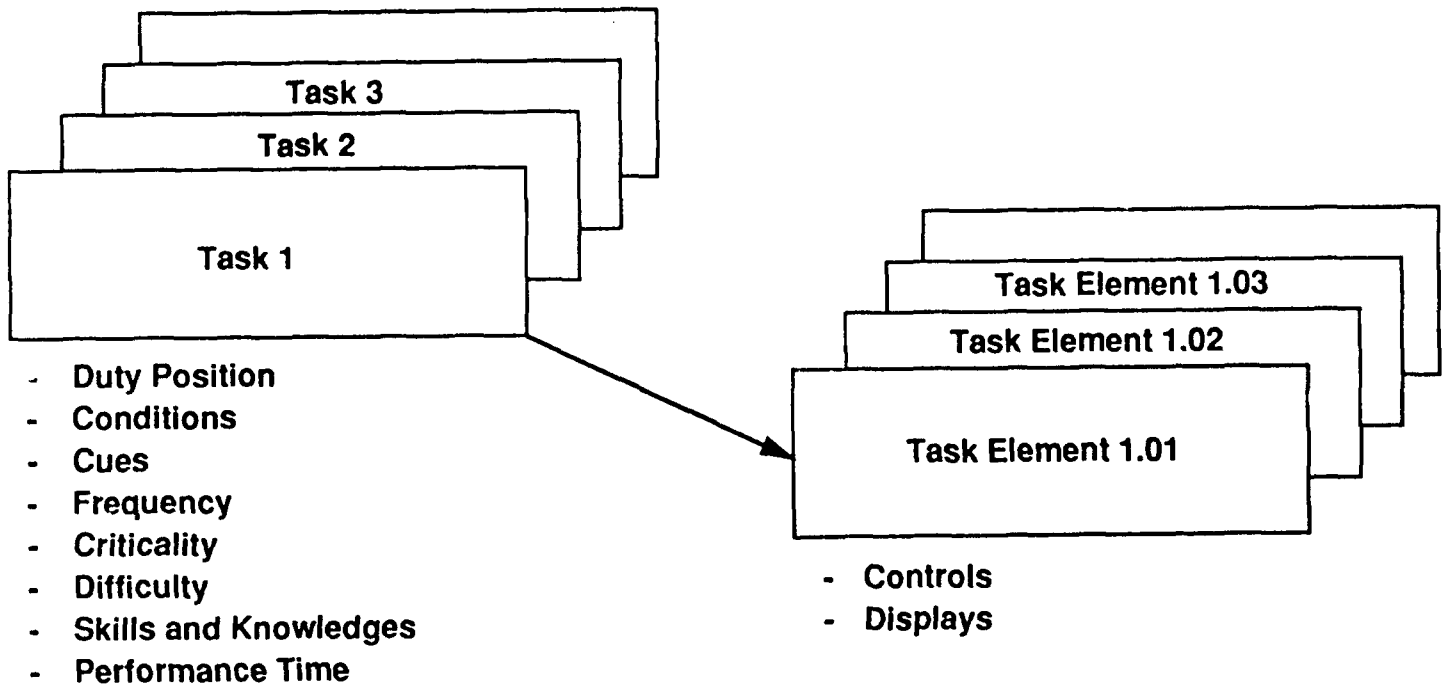


Figure 3-1. Task analysis data elements

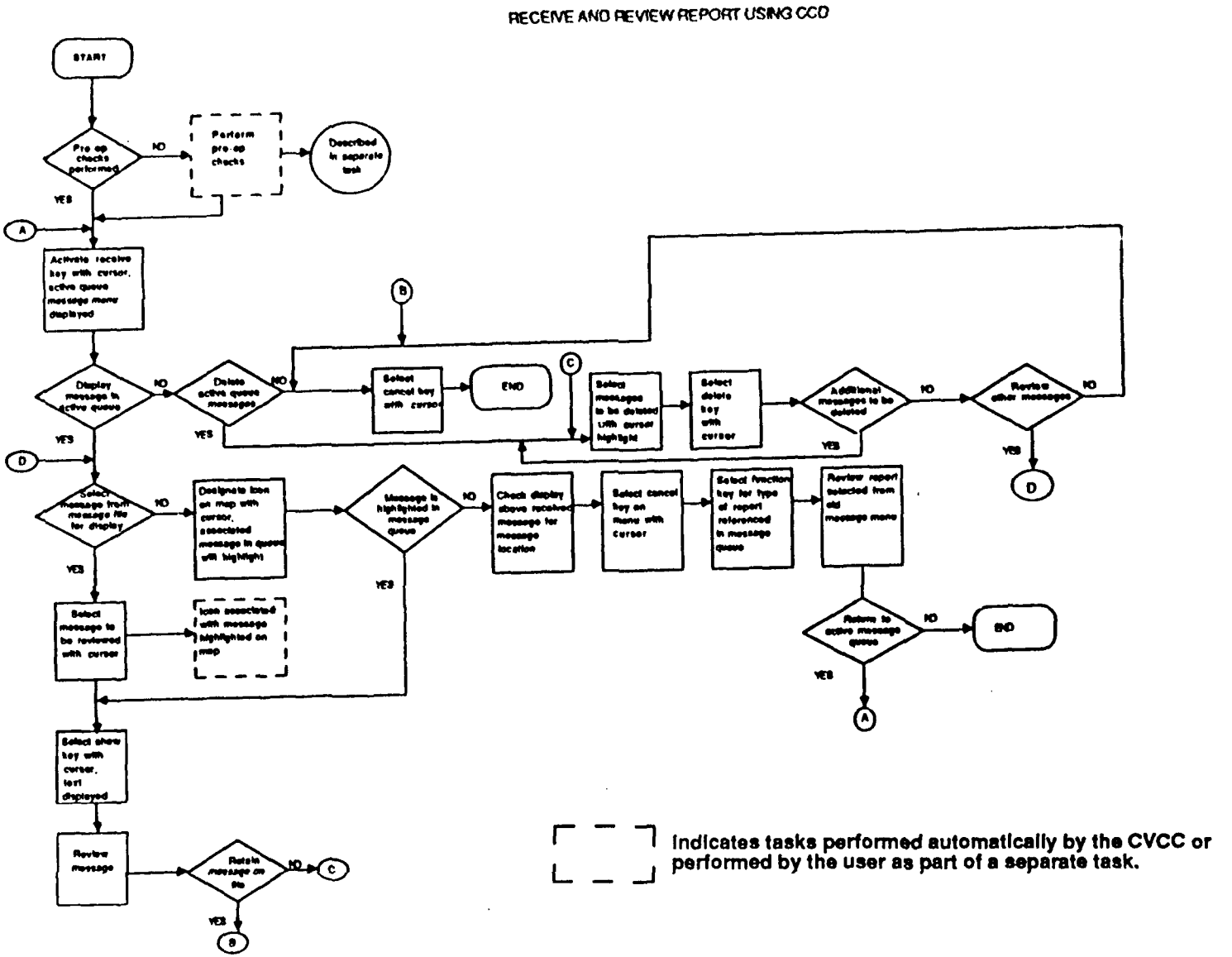


Figure 3-2. Example flowchart

training (12II) identifies training materials for platoon leaders (i.e., lieutenants). Data sources consisted of research reports by DuBois (1989), DuBois and Smith (1989), Gound and Schwab (1988), Myers, Cavallo, Eldredge and Hess '1987), and Quinkert (1987); Army Training and Evaluation Program publications (ARTEP 17-237-10-MTP and ARTEP 71-1-MTP); and soldier manuals (STP 17-12II-MQS, STP 17-19K23-SM, STP 17-19EK4-SM, FKSM 17-15-3).

The data source for identifying the unique requirements of the CVCC tasks was primarily hands-on experience of the authors. This experience was augmented with (a) the functional specifications for the CVCC system and (b) job aids provided to CVCC company-level evaluation participants.

3.5 Process for Conducting Analysis

Task elements were identified for each of the 16 CVCC tasks using available documentation. Assignments for each data element were made by the senior author, a training analyst with over 15 years experience in Army training. Assignments were based on the experiences of the analyst in directly using the CVCC and in observing users employing the CVCC during the company-level evaluation. The textual information was identified and entered into the automated data base. To facilitate entry, an entry form was created to cue the appropriate response. Flow charts were then constructed to describe the sequence of task elements within a task. The flow charts were verified by sitting in a CCTB simulator and attempting to step through the sequences indicated in the flowcharts. Once the flow charts were verified, video recordings were made. In making the videos, the flow charts were used as scripts to identify the alternative sequence for performing the elements of each task.

4.0 Data Element Definition

4.1 Task Level

Task Number -- Arbitrary number used to identify a specific task within the data base.

Task Title -- Title of task performed on CVCC.

Duty Position -- Identification of CVCC user. One of the following:

1. Company Commander
2. Platoon Leader
3. Platoon Sergeant
4. Tank Commander

Conditions of Performance -- Conditions under which the task is performed.

Performance Measures -- Potential measures that could be used to assess the adequacy of the task's performance.

Initiating Cues -- Cues which cause the CVCC user to begin the task. The generic term "tank commander" is used because all four duty positions were tank commanders. However, three of the positions (company commander, platoon leader, and platoon sergeant) have additional responsibilities.

Terminating Cues -- Cues which indicate to the tank commander that he no longer has to perform the task.

Feedback Cues -- Cues which the tank commander might receive during the performance of a task. Provides information on how well the task is being performed.

Defensive Frequency -- Frequency of performing a task during a defensive mission. All missions were approximately 3 hours in duration. One of the following:

1. Rarely - An occasional mission or exercise
2. Seldom - Every few missions
3. Regularly - Once per mission
4. Frequently - Several times per mission
5. Continuously - All during the mission

Offensive Frequency - Frequency of performing a task during an offensive mission. All missions were approximately 3 hours in duration. One of the following:

1. Rarely - An occasional mission or exercise
2. Seldom - Every few missions
3. Regularly - Once per mission
4. Frequently - Several times per mission
5. Continuously - All during the mission

Criticality[1] -- Percent of exercise participants who rated this task as their top priority during the CVCC workload assessment. Ratings were drawn from a list of priorities based on 32 tasks, only some of which are included in the task analysis. Therefore, criticality ratings do not sum to 100%.

Learning Difficulty -- This scale is the same scale used in the Army Occupational Survey program. The learning difficulty rating

---

[1]Based on unpublished data obtained during the CVCC company-level evaluation.

was based on a comparison of a task with the average learning difficulty of the set of 16 tasks.

1. Extremely Low
2. Low
3. Somewhat Below Average
4. Average
5. Somewhat Above Average
6. High
7. Extremely High

Reasons for Difficulty -- Justification for the learning difficulty rating. Reasons were identified by the training analyst.

Data Sources -- Documentation sources used to obtain information on task.

Comments[2] -- Anomalies associated with any of the data entries.

Skills -- Psychomotor or perceptual skills associated with the task.

Knowledge -- Types of cognitive information associated with the task.

Performance Time -- Estimate of the time it takes to perform the task.

4.2 TASK ELEMENT LEVEL

Task Element Number -- Arbitrary number used to identify a specific task element within a task.

Task Element Title -- Title of task element.

Displays -- Specific displays used in performing the task element.

Controls -- Specific controls used in performing the task element.

[2]Judgments provided by DRC training analysts conducting the analysis.

5.0 Task Analysis Summary

A summary of selected features of the task analysis is presented in Table 3-4. The tabulation provides a comparison of tasks with respect to frequency, criticality, learning difficulty, and performance time.

Table 3-4

Summary of Selected Features of Task Analysis

Task	Defensive Frequency	Offensive Frequency	Criticality (%)	Learning Difficulty	Performance Time
Receive and Review Report Using CCD	Continuously	Continuously	21.0	Somewhat Above Average	5 min 0 sec
Prepare and Submit Spot Report Using CCD	Continuously	Frequently	14.4	Average	1 min 0 sec
Prepare and Submit Shell Report Using CCD	Frequently	Frequently	9.3	Somewhat Below Average	1 min 0 sec
Prepare and Submit Contact Report Using CCD	Frequently	Frequently	33.5	Average	1 min 0 sec
Prepare and Submit Call for Fire Report Using CCD	Frequently	Frequently	7.5	Average	1 min 30 sec
Prepare and Submit SITREP Report Using CCD	Continuously	Frequently	13.3	Average	2 min 0 sec
Prepare and Submit NBC Report Using CCD	Regularly	Regularly	2.2	Somewhat Above Average	2 min 0 sec
Designate and Transmit Route Coordinates Using CCD	Frequently	Continuously	37.4	Somewhat Above Average	5 min 0 sec
Receive and Review Route Coordinates Using CCD	Regularly	Regularly	0	Somewhat Below Average	1 min 0 sec
Prepare and Submit Adjust Fire Report Using CCD	Frequently	Frequently	7.5	Somewhat Below Average	1 min 0 sec
Prepare and Submit Ammunition Report Using CCD	Frequently	Frequently	0	Low	1 min 0 sec
Prepare and Submit Intelligence Report Using CCD	Frequently	Frequently	0	Average	1 min 30 sec
Receive, Review and Retransmit FRAGO Report Using CCD	Regularly	Seldom	0	Average	2 min 0 sec
Search for Targets Using CITV	Frequently	Continuously	0	Average	3 min 0 sec
Identify and Prioritize Targets Using CITV	Frequently	Continuously	25.1	Somewhat Above Average	3 min 0 sec
Control Map Display Functions Using CCD	Frequently	Regularly	0	Average	1 min 30 sec

6.0 References

Ainslie, F.A., Leibrecht, B.C., and Atwood, N.K. (in preparation). Combat vehicle command and control systems: III. Simulation-based evaluation of the soldier-machine interface (SMI). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Department of the Army. (October 1988). ARTEP 17-237-10-MTP, Mission training plan for the tank platoon. Washington, DC: Author.

Department of the Army. (October 1988). ARTEP 71-1-MTP, Mission training plan for the tank and mechanized infantry company and company team. Washington, DC: Author.

Department of the Army. (September 1988). FM 17-12-1, Tank Combat Tables, M1. Washington, DC: Author.

Department of the Army. (December 1990). Preliminary Draft Equipment Publication, PDEP 9-2350-264-10-1 (M1A2). Operator's manual. Operator controls, PMCS, and operation under usual conditions (Vol. 1). Washington, DC: Author.

Department of the Army. (September 1986). STP 17-12II-MQS, Military qualification standard 11, SC12, armor officer. Washington, DC: Author.

Department of the Army. (August 1989). STP 17-19D1-SM, Soldier manual MOS 19D, cavalry scout. Washington, DC: Author.

Department of the Army. (August 1988). Soldier Manual, STP 17-19EK4-SM, Armor platoon sergeant. Washington, DC: Author.

Department of the Army. (August 1989). STP 17-19E1-SM, Soldier manual MOS 19E, M48/M60 series armor crewman. Washington, DC: Author.

Department of the Army. (November 1989). Soldier Manual, STP 17-19K23-SM. M1/M1A1 Abrams armor crewman. Washington, DC: Author.

Department of the Army. (November 1989). STP 17-19K24-SM, Soldier manual MOS 19K, M1/M1A1, Abrams armor crewman. Washington, DC: Author.

Department of the Army. (January 1989). STP 21-24-SMCT, Soldier manual of common tasks (SL2/3/4). Washington, DC: Author.

Department of the Army. (March 1987). STP 21-II/III-M, Military qualifications standards manual of common tasks. Military qualification standards system: Commanders and supervisors. Washington, DC: Author

Department of Defense. (January 1979). Human engineering requirements for military systems, MIL-H-46855B. Washington, DC: Author.

Dubois, R. S. (1989). Simulation-based command, control, and communication exercise for armor small unit commanders (Technical Report 866). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (AD A218 869)

DuBois R. S. & Smith, P. G. (1989). A simulation-based evaluation of a position navigation system for armor: Soldier performance, training, and functional requirements (Technical Report 834). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (AD A210 696)

Gound, D. & Schwab, J. (1988). Concept evaluation program of simulation networking (SIMNET) (Final Report). Fort Knox, KY: U.S. Army Armor and Engineer Board.

Jorgensen, C.C. & O'Brien, L.H. (1983). The early training estimation system (ETES): An automated training needs assessment technique. Training Technology Journal, 1, 42-49.

Leibrecht, B.C., Kerins, J.W., Ainslie, F.M., Sawyer, A.S., Childs, J.M., & Doherty, W.J. (in preparation). Combat vehicle command and control systems: I. Simulation-based company-level evaluation. Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Meister, D. (1985). Behavioral analysis and measurement methods. New York: John Wiley & Sons, Inc.

Miller, D. C. & Chung, J. W. (1987). SIMNET-D capabilities and overview. Cambridge, MA: BBN Laboratories, Inc.

Morey, J. C., Wigginton, D., & O'Brien, L. H. (in preparation). Workload assessment for the combat vehicle command and control company-level evaluation. Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Myers, L. B., Cavallo, K. M., Eldredge, D., & Hess, L. J. (1987). Task analysis of M1A1 tank crew members (Report No. HEL 22). Aberdeen Proving Ground, MD: U.S. Army Human Engineering Laboratory.

O'Brien, L. H., Morey, J. C., & Wigginton, D. (in preparation). User guide: Performance assessment in advanced distributed simulators. Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Quinkert, K. A. (1987). Preliminary training requirements analysis for the commander's independent thermal viewer (CITV) (Research Product 87-19). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (AD A185 467)

U.S. Army Armor Center. (February 1989). FKSM 17-15-3, Tank platoon SOP. Fort Knox, KY: Author.

U.S. Army Training and Doctrine Command. (July 1990). TRADOC Pamphlet 351-13 (Draft), Systems approach to training. Fort Monroe, VA: Author.

7.0 Glossary

AMMO	Ammunition
CCD	Command and Control Display
CCTB	Close Combat Test Bed
CFF	Call for Fire
CITV	Commander's Independent Thermal Viewer
CVCC	Combat Vehicle Command and Control
FLOT	Forward Line of Own Troops
FRAGO	Fragmentary Order
GLOS	Gunner Line of Sight
GPS	Gunner Primary Sight
IFF	Identification Friend or Foe
LRF	Laser Range Finder
MOS	Military Occupational Specialty
MQS	Military Qualification Standards
NBC	Nuclear, Biological, and Chemical

OPORD	Operation Order
POSNAV	Position Navigation
SINCGARS	Single Channel Ground and Air Radio System
SIMNET-D	Simulation Networking - Developmental
SITREP	Situation Report
SMI	Soldier-Machine Interface
TC	Tank Commander
TRADOC	Training and Doctrine Command

APPENDIX A

CVCC SYSTEM DESCRIPTION

CVCC System Description

The vehicle commander's workstation in a CVCC-equipped tank simulator of the Fort Knox CCTB facility is shown in Figure A-1. Table A-1 lists the simulator capabilities which characterized the CVCC configuration. The key features included the Command and Control Display (CCD--previously referred to as IVIS), the Commander's Control Handle, the CITV, Vision Blocks in all three crew stations (vehicle commander, gunner, driver), Grid Azimuth Indicator, Odometer, Laser Range Finder (LRF), Gunner's Primary Sight (GPS), GPS extension (GPSE) in the commander's station, Turret Reference Display, the Autoloader, and simulated Single Channel Ground Airborne Radio System (SINCGARS) without terrain modeling capability.

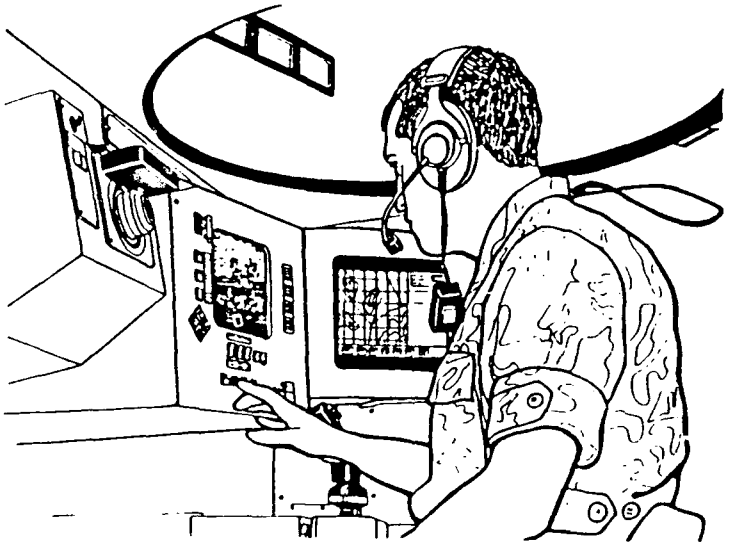


Figure A-1. Vehicle commander's CVCC workstation.

Table A-1

Basic Capabilities of a CVCC Simulator Configuration

Navigation

- Vision blocks
- Paper map with acetate overlays
- Grid azimuth indicator
- Odometer
- Laser Range Finder (LRF)
- CCD
- POSNAV
- Waypoint Transmission

Target acquisition/engagement

- Vision blocks
- GPS/GPSE (with thermal, 3X/10X, LRF)
- Turret reference display
- CITV
  - Target Designate
  - Target Stack
  - Identification Friend or Foe (IFF)

Communications

- Intercom (for crew communication)
- SINCGARS radio (voice)
- CCD/Reports
- CCD Radio Interface Unit

Command and Control Display Configuration

The CCD is pictured schematically in Figure A-2. The 10.25-inch diagonal cathode ray tube (CRT) displaying the CCD was mounted to the right of the vehicle commander. A 7 X 5.75 inch rectangular working area of the CRT face comprised the primary user interface. Five functional sections organized this interface: (a) full-feature, five-color Tactical Map (4.5 X 5.12 inches) with directional own-vehicle icon; (b) Information Center displaying date/time group, own grid location, own vehicle heading, and own call sign; (c) fixed array of dedicated soft-switch menu keys accessing specific functions; (d) working menu area displaying queue/file listings, sub-menus, and selected functions; and (e) message receipt alert key.

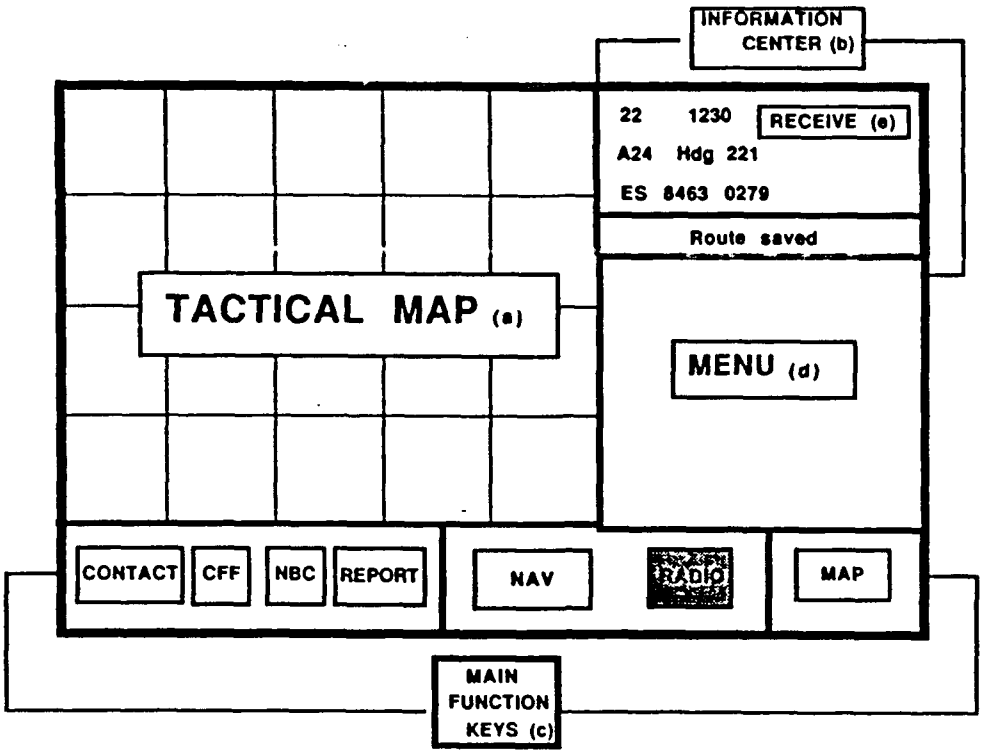


Figure A-2. Schematic drawing of the CCD user interface with the five primary functional areas labelled.

Table A-2 lists the C³-related capabilities of the CCD concept configuration. A brief overview of the system follows.

Map functions. The basic Tactical Map was a Universal Transverse Mercator (UTM) grid representation of the terrain surrounding the tank's location from an overhead perspective. Digital data in the CCTB terrain data base constituted the basis for all resident map graphics. Four map scales were available at all times--1:25,000, 1:50,000, 1:125,000, and 1:250,000--with at least a few seconds processing time required for rescaling. The CCD provided several additional features for optional selection by the vehicle commander: contour lines, rivers, roads, vegetation, and UTM grid lines, all of which were color coded. Also, the system could display graphic tactical map overlays received digitally.

Several map scroll functions enabled the vehicle commander to control positioning of the map in relation to his tank icon. The basic scroll function maintained the icon in the center of the map, scrolling the map as the tank moved. An option was to lock the map in position, maintaining a view of the same terrain segment regardless of where the tank moved. The vehicle commander could reposition the map to show a new terrain segment, allowing him flexibility to inspect icons or terrain features of interest.

Table A-2

C^3 Capabilities of the CCD

Navigation

- Grid map
- Terrain map
- Graphic overlays
- Own vehicle location (grid + icon)
- Directional icon (own vehicle)
- Friendly vehicle locations
- Report-based icons
- Route waypoints
- Driver's Steer-to-Display
- Waypoint Autoadvance
- Transmission of routes

Communications

- Report preparation (text)
- LRF input to reports
- Send/receive/relay reports (text)
- Receive/relay graphic overlays
- Report-based icons

General Characteristics

- Thumb control
- Touchscreen control
- Color display

Finally, he could position his tank icon in an off-center location while the map scrolled under the tank icon.

The Tactical Map could display key symbols (icons) representing battlefield information. These included report-based and route-based icons. Reports being prepared generated icons appearing on the map (e.g., CONTACT reports generated enemy vehicle icons). Upon completing the report, the vehicle commander could post these icons to the map. Waypoints generated under Navigation functions appeared on the map with connecting lines, forming graphic routes. The Tactical Map automatically displayed icons representing all friendly vehicles located on the terrain segment currently displayed. This was labelled the "mutual POSNAV" feature. Finally, map icons (e.g., minefield symbols) signalled reports which were received digitally. These icons remained on the map until the vehicle commander took action on the

report or until the report automatically transferred to the "old" file (a report-type filing system). Exceptions to the latter rule existed: when CONTACT and INTELLIGENCE reports transferred to the old file, their icons automatically posted to the map.

Navigation functions. The CCD enabled the vehicle commander to create and modify routes for navigation and to send route information to his driver. In addition, the CCD permitted any vehicle commander to transmit a route digitally to other vehicles in his unit. Routes were generated by designating up to six locations on the map (waypoints). An icon for each waypoint appeared on the map, while lines connected successive waypoints. The vehicle commander could send waypoints to his driver one at a time--manually or automatically by means of an Autoadvance option.

The Navigation subsystem included a Steer-to-Display in the driver's compartment, mounted to the right of the steering column (the T-bar). Figure A-3 depicts the driver's T-bar, to the right of the T-bar is the Steer-to-Display which presented alphanumeric information about the tank's current and required heading as well as distance from the waypoint. In addition, the display incorporated a graphic indicator with a pointer showing how the driver should steer to reach and maintain the proper heading, represented by the 12 o'clock position. Note in Figure A-3 that the pointer is approximately at the 4 o'clock position, thus the deviation (DEVN) is 111 degrees. Given this situation, the driver would neutral steer the tank 111 degrees to the West (at which time the pointer would be at the 12 o'clock position) and drive the eight kilometers to the waypoint.

Also of value in navigating and positioning was the directional own-tank icon displayed on the CCD tactical map. This helped maintain proper orientation and direction of movement. Additionally, both UTM grid location and grid azimuth heading were available in the CCD information center.

Report functions. The CCD supported preparation of reports by means of menu-driven screen forms. The vehicle commander was able to prepare any of the nine types of reports available on the CCD by filling in fields appearing in the working menu area. Table A-3 lists these report types along with information about number of fields in each. The vehicle commander could call up CONTACT, CALL FOR FIRE, and NUCLEAR-CHEMICAL-BIOLOGICAL (NBC) report forms directly from the fixed menu keys. The remaining report forms required him to call up a report menu first, then choose a report type from the options appearing in the working menu area.

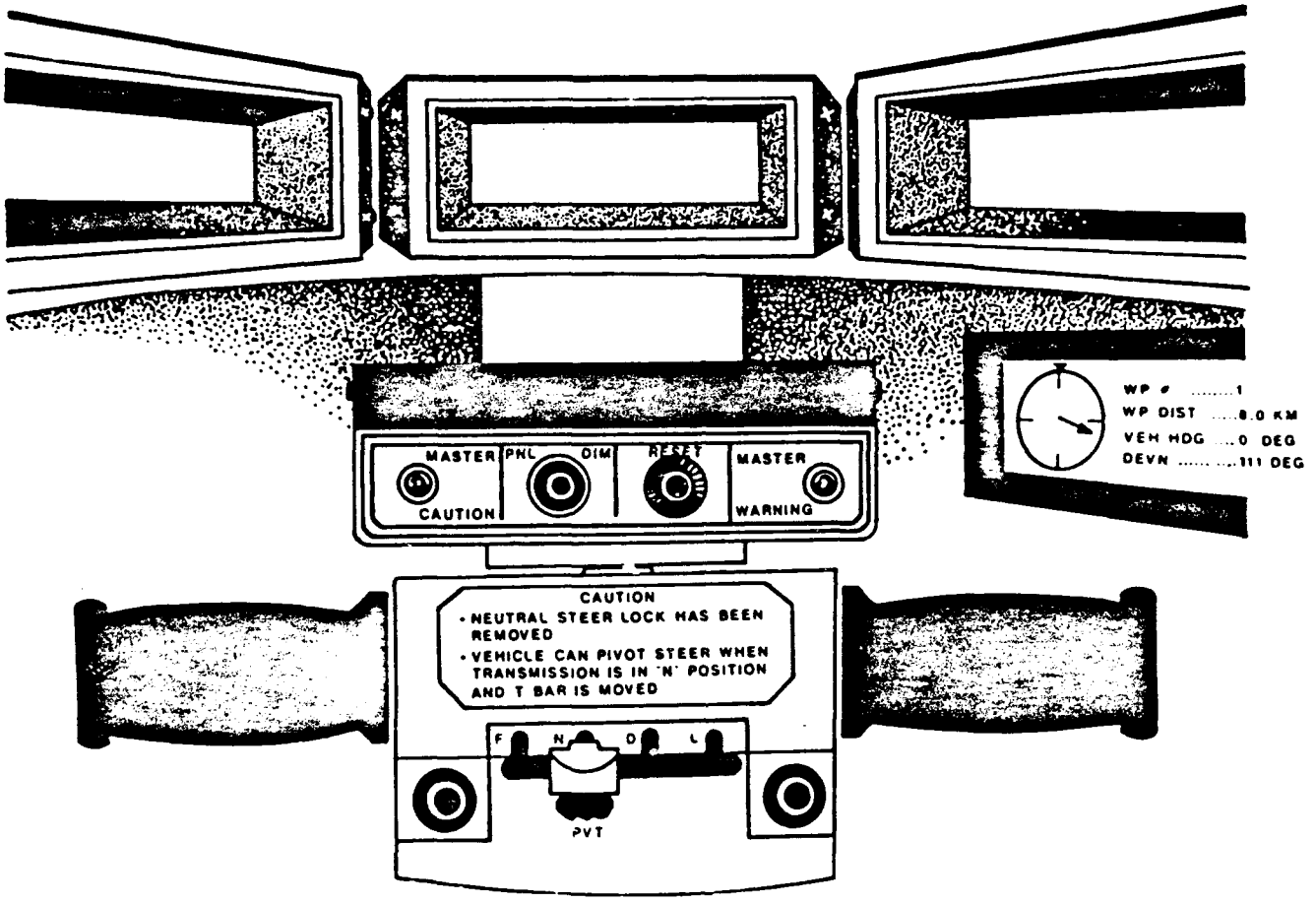


Figure A-3. Drawing of the driver's T-bar showing the Steer-to-Display on the right.

Table A-3

Report Preparation Forms Available on the CCD

Report Type	Number of of option-input fields	Number of of grid-input fields	Number of Pages
CONTACT	4[a]	4[a]	1
CALL FOR FIRE	1	1	1
ADJUST FIRE	3	1	1
SPOT	9	2	3[b]
SHELL	2	1	1
SITUATION	8	2	3[b]
AMMUNITION	5	0	1
INTELLIGENCE	8	6	4[b]
NBC	7	2	3[b]

[a] - Up to four paired ID-location fields could be filled in.
[b] - Includes a final summary page.

Fill-in fields usually called for selecting inputs from option sets provided by the CCD. Fields dealing with location or heading information called for grid inputs from the tactical map or from lasing to a vehicle or terrain point. Blank fields were permitted. Since typically only four or five fields could fit in the working menu area, four of the reports required more than one "page" for complete presentation, the final page being a summary of all fields.

At any time the vehicle commander could leave a report preparation screen without completing or sending the report. That report preparation screen would remain "behind" any subsequent screens without loss of information and could be returned to for later completion. He might, for example, leave to prepare another type of report or go to the MAP function to change scales. Multiple types of reports could be open at the same time, but only one report of a given type (e.g., CONTACT) could be open at any time. No more than one report could be visible on the screen at a given moment. The vehicle commander could complete a report (and thereby dispose of that report form) by either deleting, cancelling, or sending it, using a sequence of soft-switch presses.

Digital report transmission. A simulated radio interface unit (RIU) enabled the vehicle commander to transmit digital reports prepared on the CCD. Co Cdrs and Plt Ldrs had access to two nets: Co Cdrs had the battalion and company nets, while Plt Ldrs had the company and their platoon nets. Only the platoon net was available to the platoon sergeant and the wingmen. A routing menu offered the option of sending any report on any radio net available for the vehicle commander's use, including simultaneous transmission if two nets were available. For example, a platoon leader could send a report to the TCs within his platoon (platoon net), to the Co Cdr and the other Plt Ldrs (company net), or to all of them at the same time. A default net (based on transmission direction--upward or downward) existed for each report type. If a Co Cdr or Plt Ldr sent or relayed an INTELLIGENCE Report, a FRAGO, an Overlay or a Route, the default was the downward-going net (TCs had no downward-going net). For the remainder of reports the default was the upward-going net. Upon transmission, a report copy automatically transferred to the sender's old file, from which it could be retrieved later and resent. A "MESSAGE SENT" confirmed transmission, displayed in the Information Center, but there was no feedback indicating that addressees had received and read the report.

When a vehicle commander received a transmitted report, three cues appeared at once: the message receipt alert key (located in the upper right corner of the CCD) lighted up, an audible cue sounded in the vehicle commander's headset (three tone beeps for a high priority report, one beep for others), and an icon appeared on the tactical map (blinking for the first five seconds). A report remained in the receive queue for five minutes, as did its associated icon remain on the map. As high priority reports (ADJUST FIRE, CALL FOR FIRE, CONTACT, FRAGO, INTELLIGENCE, and NBC--report priority being based on immediacy of information) arrived, they went to the head of the queue. Activation of the RECEIVE key called up the Receive Queue, listing the report type, originator, and time received for each report, enabling the vehicle commander to select a report for display in the working menu area. Up to five reports were displayed in the Receive Queue at a time, but it could be scrolled forward and backward to view the complete Queue.

If the vehicle commander failed to retrieve a report from the Queue within five minutes, the report automatically transferred to the old file (unless the vehicle commander was viewing the report when the five minutes elapsed). When transferred to the old file CONTACT and INTELLIGENCE reports automatically posted an icon to the map. For other reports, the associated icon, if not manually posted, disappeared from the map.

Once the vehicle commander selected a report to read, he could review it at his own pace. In the case of a multi-page report, only the summary page appeared. For example, when ready to terminate his review, he could cancel and file the report (with an option to post to the tactical map an icon representing it), he could relay it (see below), or he could delete it. Unless he deleted it, he could subsequently retrieve the same report as many times as he desired.

If the vehicle commander decided to pass a report along to other members of his unit, he could exercise the option to relay it (there was no capability to edit reports). Relaying a report involved the same steps as transmitting one. The same options for routing were available. The system did not limit the number of times a given report could be relayed.

Control device. The vehicle commander controlled the operation of the CCD by means of a cursor appearing on the face of the display screen. He selected menus and functions by positioning the cursor on the desired key. The CCD afforded the vehicle commander the option of manipulating the cursor position by touching with his finger the face of the touch-sensitive screen or by using a thumb control mounted on his control handle. Touching the screen automatically jumped the cursor to the new position designated by the finger's contact with the screen. When satisfied with the cursor position, the vehicle commander removed his finger from the screen. This action initiated the menu or function corresponding to the key on which the cursor rested, or resulted in a grid location input to a report if the cursor was located on the map. The cursor was offset from the touchpoint to enable the vehicle commander to see the cursor location.

When operating the thumb control, the vehicle commander could move the cursor in virtually any direction at a variable speed. With the cursor resting on the desired key, release of the thumb control initiated the corresponding menu or function.

Utility functions. The CCD provided a small set of utility functions with which to manage prepared and received reports. The automatic transfer of reports from the Receive Queue to the old file was one such function. The vehicle commander could also delete reports which he created, both during preparation and after transmission, as well as any reports he had received. The latter action could be accomplished without reviewing the contents of the report or after it had been filed. Deletion resulted in no record of the contents. To declutter the tactical map, the vehicle commander could delete icons one at a time or he could select a menu option to delete all icons older than a specified time.

Commander's Independent Thermal Viewer Configuration

The CITV afforded the vehicle commander a battlefield viewing capability and an independent laser locator. In terms of tactical utility, the diverse functions of this system spanned navigation; battlefield surveillance; target acquisition, identification, and management; and fire control. Table A-4 lists the functional capabilities of the CITV.

Mounted directly to the front of the vehicle commander, the CITV interface arrayed control switches around three sides of a central display screen (Figure A-4). Switches on the right margin of the interface were nonfunctional. The vehicle commander controlled operation of the CITV via inputs through the functional switches and through push buttons on his control handle. The control handle was also used to control manual movement of the CITV sensor. The interface components entailed: (a) rectangular (6.5 X 5.88 inches) monochrome CRT display screen with own vehicle icon and sighting reticle; (b) power switch with OFF, STANDBY, and ON positions (three-position toggle); (c) push-button selector switches for basic mode (CITV, GPS); (d) push-button selector switches for operational mode (AUTOSCAN, MANUAL SEARCH, GLOS);

Table A-4

Capabilities of the CITV

Independent thermal search
3X and 10X magnification
White-hot and black-hot polarity
Manual Search
Autoscan
Independent Laser Range Finder
Identification Friend or Foe (IFF)
Target Designate
Target Stack
Gunner's Line of Sight (GLOS)
Own vehicle icon (directional, all parts moving)

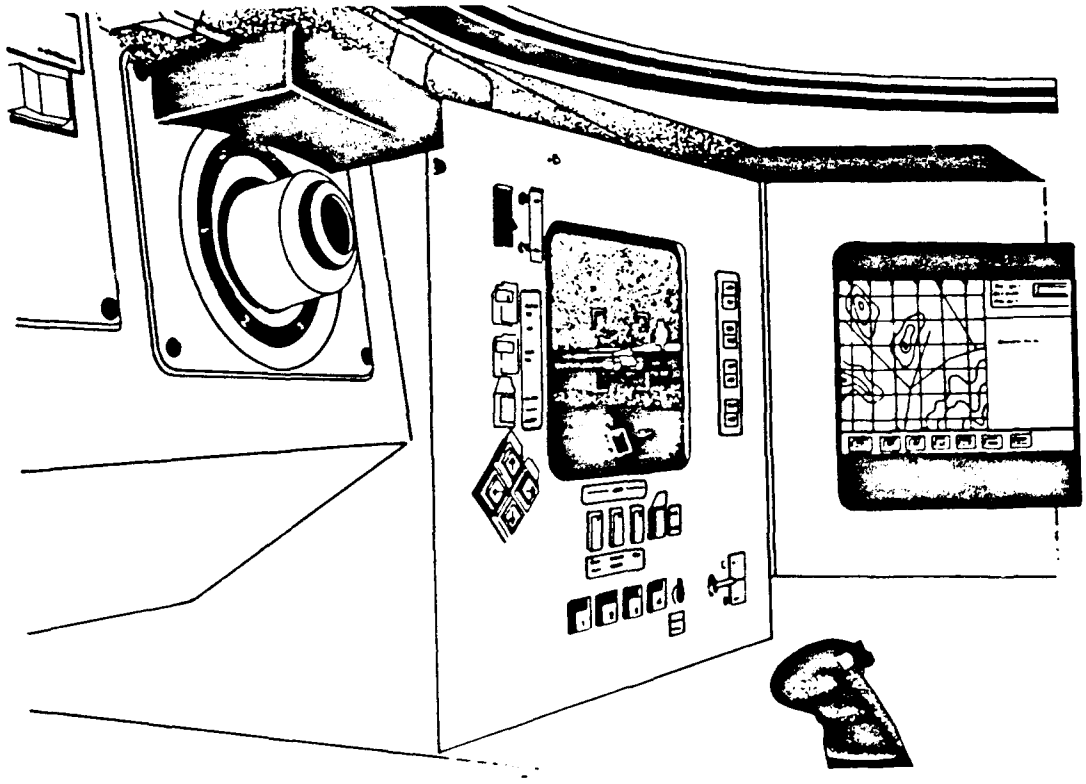


Figure A-4. Drawing of the vehicle commander's crewstation in a manned tank simulator with the CITV in the center.

(e) two-position push-button switch for polarity (WHITE-HOT, BLACK-HOT); (f) Autoscan control switches for setting sector limits and adjusting scan rate; (g) vehicle commander's Target Stack display with four push-button target selector switches and ON-OFF push-button switch; (h) gunner's Target Stack display similar to the vehicle commander's (depicted in Figure A-5, along the bottom of the gunners crewstation); (i) control handle with push buttons for switching magnification (3X, 10X), operating the laser, and designating targets (depicted in Figure A-6). Summarized below is an overview of the system functions.

Basic modes. In the GPS mode, the CITV was functionally inactivated, with the last active scene from the sensor remaining static on the screen. Requiring the vehicle commander to use his

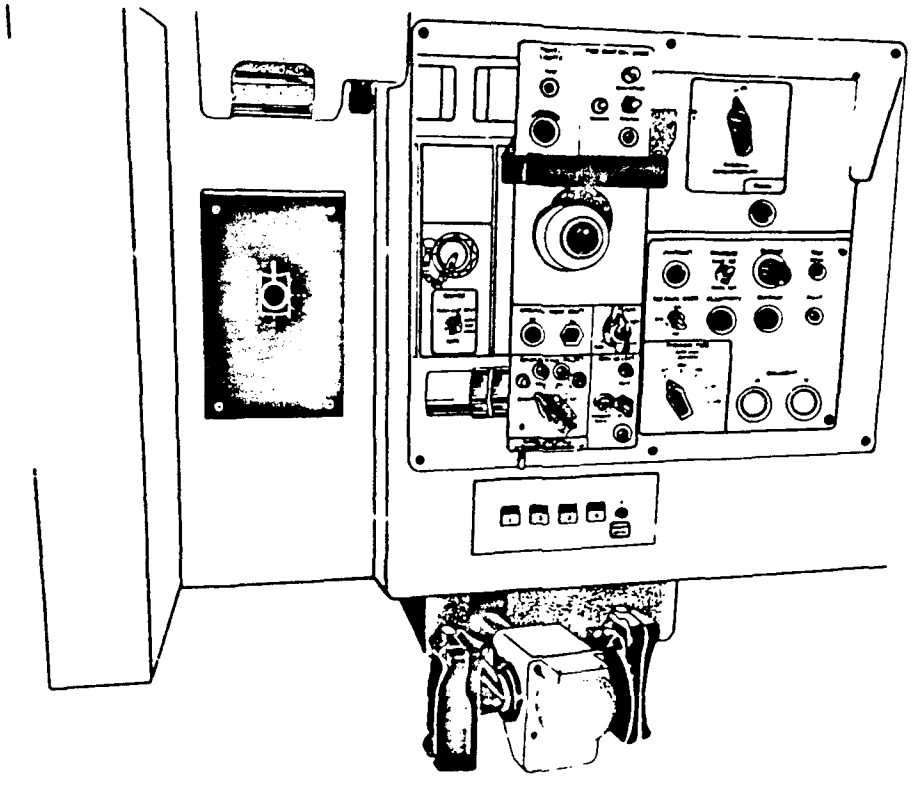


Figure A-5. Drawing of the gunner's crewstation, with the Target Stack buttons along the bottom, labelled one through four.

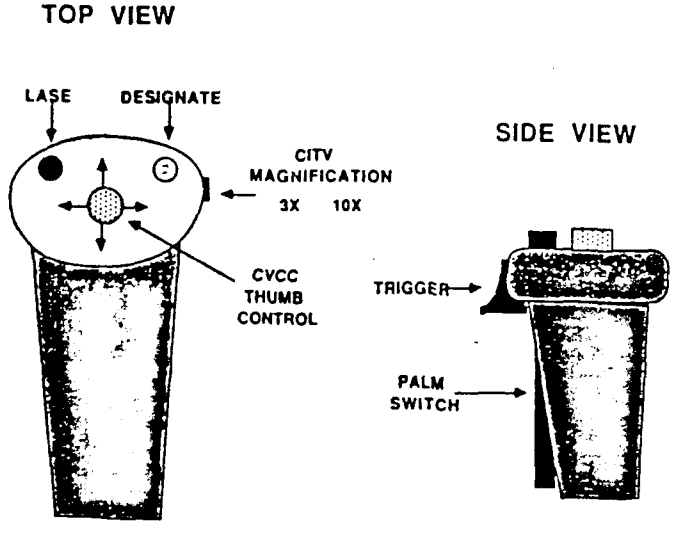


Figure A-6. Drawing of the commander's control handle with the functions labelled.

GPSE for viewing, this mode enabled him to override the gunner in moving the turret/gun tube and firing. The CITV mode permitted the vehicle commander to select three types of surveillance--GLOS, Manual Search and Autoscan. The GLOS mode slaved the CITV line of sight to the main gun alignment, except when the vehicle commander depressed his palm switch to activate Manual Search. The slaved alignment provided a view overlapping the gunner's view while enabling the vehicle commander to operate his own laser and change magnification and polarity. The Manual Search and Autoscan capabilities, both providing independent surveillance, are discussed below. For the purposes of this research effort the vehicle commander could not move or fire the main gun from the CITV mode.

In all CITV modes the display screen presented optional fields of view: wide field (3X magnification, 7.5 X 10 degrees) and narrow field (10X magnification, 2.5 X 3.3 degrees). In providing uninterrupted horizontal sweep capability, the system afforded a 360 degree field of regard. The vertical expanse of the field of regard ranged from +20 to -12 degrees. According to his preference, the vehicle commander could select White-Hot or Black-Hot display options. In White-Hot mode, warmer objects within the field of view appeared "white" against a darker background. In Black-Hot mode, warmer objects appeared black against a lighter background.

The own tank icon present on the display screen depicted the directional orientation of the turret/gun and CITV. The CITV indicators included the CITV's line of sight as well as the Autoscan sector limit markers. The entire icon rotated to represent the proper grid azimuth heading of the tank hull. The CITV tank icon was consistent with the CCD own tank icon.

Manual Search. In selecting Manual Search, the vehicle commander could control the CITV's line of sight manually by manipulating his control handle. Both direction (horizontal, vertical, and oblique) and speed of movement could be controlled simultaneously. This mode allowed the vehicle commander to vary at will his pace and pattern as he searched for targets. It preserved access to other control options such as magnification, polarity, and target designation.

Autoscan. Autoscan permitted the vehicle commander to sweep automatically the CITV's line of sight back and forth across a specified sector at a set rate of speed. The search pattern required no input from the vehicle commander once initial parameters were set. Setting or resetting left and right sector limit markers defined the portion of the field of regard to be scanned. To adjust scan rate, the vehicle commander could increase or decrease the current rate, which began at a default value upon initialization. The entire 360 degree field of regard

could be selected as the scanning sector, if desired. As with Manual Search, Autoscan maintained availability of secondary control options such as polarity, magnification, and target designation. The latter function required the vehicle commander to activate a temporary Manual Search option by depressing his palm switch.

Independent Laser Range Finder. The CITV system included a laser capability independent of the standard LRF. The vehicle commander could exercise this capability in GLOS, Manual Search, and Autoscan modes; lasing in the latter mode required interruption of scanning to stabilize the sight picture. Each lase event produced a range-to-target reading in meters, displayed in the lower left corner of the display screen; this reading could indicate flawed determinations and double returns. Lasing also supported the IFF function, which had an 85% accuracy rate and generated symbology characterizing the target as friendly, enemy, or uncertain. This symbology appeared in the upper left portion of the display.

Target designation. In the Manual Search and Autoscan modes, the vehicle commander could use the Designate function to quickly hand off a target to his gunner. Having identified an enemy target for immediate engagement, the vehicle commander pressed the DESIGNATE button on his control handle. This rapidly slewed the main gun to the CITV's line of sight, overriding the gunner's controls. The vehicle commander then could hand off the target.

Target Stacking. The CITV configuration incorporated a target management feature referred to as Target Stack. In both the Manual Search and Autoscan modes, the vehicle commander could use this feature to cue the gunner about available targets. After lasing to and identifying an enemy target the vehicle commander pressed one of four buttons to mark the target's location. He could cumulate up to four targets in the stack. The vehicle commander placed targets in the stack in priority order (number one being highest priority). As the vehicle commander stacked targets, cuing lights on the gunner's display came on and, for each target, two LEDs indicated the relative position of the target with respect to the direction of the main gun (left, right, or centered). The gunner could use these indicators to anticipate the direction in which the turret would slew after pushing a target stack button. After the gunner engaged a target selected from the target stack, it dropped from the stack.

Radio nets

The simulated SINCGARS radio system serviced five radio nets--battalion, company, and three platoons. The manned simulators connected to these nets in a doctrinally realistic arrangement. The Co Cdr, Plt Ldrs, and platoon sergeant accessed two nets each,

while the two wingmen accessed only one. An RIU linked the CCD with the SINCGARS system to enable electronic transmission of messages via digital burst technique. The voice radio net scheme defined the automated routing options for each vehicle commander except the platoon sergeant, who could transmit CCD messages on only the platoon net.

APPENDIX B

TASK ANALYSIS DATA

Task Analysis Index

CVCC TASK AND TASK ELEMENT DATA FORM

Task Number 1

TASK TITLE: Receive and Review Report Using CCD

DUTY POSITION

Company Commander
Platoon Leader
Platoon Sergeant
Tank Commander

CONDITIONS

Tactical or nontactical situation under all weather conditions
All types of terrain
May be performed in an NBC environment
M1A2 tank, simulator or stand alone situation
Use PDEP 9-2350-264-10-1 (M1A2)

PERFORMANCE MEASURES

Report generation time
Report accuracy
Report completeness

INITIATING CUES

Receive Message light illuminates
Voice communications (report has been transmitted)

TERMINATING CUES

Message reviewed
Message deleted
Message canceled

FEEDBACK CUES

None

DEFENSIVE FREQUENCY

Continuously - All during the mission

OFFENSIVE FREQUENCY

Continuously - All during the mission

CRITICALITY: 21.00%

21.0 percent of the workload respondents ranked this task as their top priority task.

LEARNING DIFFICULTY

Somewhat above average

REASON FOR DIFFICULTY

Operator must keep track of Receive Message light when illuminated, and attempt to address those messages in the receive queue prior to 5 minutes elapsing or message is automatically forwarded to the message file. Messages are coming in from several different sources.

DATA SOURCE

CVCC exercise observations
Workload data analysis

COMMENTS

None

SKILLS

Manipulate display cursor
Act on message while still in receive queue (5 minutes).

KNOWLEDGE

Message alerts
Icon association
Function keys
Queue/file differences

PERFORMANCE TIME: 5 minutes, 0 seconds

Task Element Number 1.01

TASK ELEMENT TITLE: Display message in active queue

DISPLAYS

CCD display

CONTROLS

CCD control panel
Commander's control handle
Cursor

Task Element Number 1.02

TASK ELEMENT TITLE: Display message in message storage file

DISPLAYS

CCD display

CONTROLS

CCD control panel
Commander's control handle
Cursor

Task Element Number 1.03

TASK ELEMENT TITLE: Review message in active/storage file

DISPLAYS

CCD display

CONTROLS

CCD control panel
Commander's control handle
Cursor

Task Element Number 1.04

TASK ELEMENT TITLE: Select messages for deletion or cancellation

DISPLAYS

CCD display

CONTROLS

CCD control panel
Commander's control handle
Cursor

CVCC TASK AND TASK ELEMENT DATA FORM

Task Number 2

TASK TITLE: Prepare and Submit Spot Report Using CCD

DUTY POSITION

Company Commander
Platoon Leader
Platoon Sergeant
Tank Commander

CONDITIONS

Tactical or nontactical situation under all weather conditions
All types of terrain
May be performed in an NBC environment
M1A2 tank, simulator or stand alone situation
Use PDEP 9-2350-264-10-1 (M1A2)

PERFORMANCE MEASURES

Report generation time
Report accuracy
Report completeness

INITIATING CUES

Initial visual contact
Receive direct fire
Receive indirect fire
Receive air attack

TERMINATING CUES

Report Sent message received on display

FEEDBACK CUES

None

DEFENSIVE FREQUENCY

Continuously - All during the mission

OFFENSIVE FREQUENCY

Frequently - Several times per mission

CRITICALITY 14.40%

14.4 percent of the workload respondents ranked this task as their top priority task.

LEARNING DIFFICULTY

Average

REASON FOR DIFFICULTY

Limited time
Simultaneous tasks

DATA SOURCE

CVCC exercise observations
Workload data analysis

COMMENTS

The spot report is the preferred method of reporting contact but due to time constraints and the situation, sometimes the tank commander will make this type of abbreviated contact report.

SKILLS

Touch screen cursor control
Commander's control handle in conjunction with CITV.

KNOWLEDGE

Enemy units
Differences in enemy unit activities
Priority in routing report

PERFORMANCE TIME: 1 minute, 30 seconds

Task Element Number 2.01

TASK ELEMENT TITLE: Operate CCD Function Keys

DISPLAYS

CCD display
CCD map display

CONTROLS

CCD function keys

Task Element Number 2.02

TASK ELEMENT TITLE: Determine Enemy Unit Situation

DISPLAYS

CITV display
Commander's cupola vision blocks
IFF display

CONTROLS

CITV function switches
CCD function keys
Commander's control handle

Task Element Number 2.03

TASK ELEMENT TITLE: Operate Laser Rangefinder to Determine Enemy Location

DISPLAYS

CITV display
IFF display

CONTROLS

Commander's control handle
CITV function switches

Task Element Number 2.04

TASK ELEMENT TITLE: Use Map Display to Determine Enemy Location

DISPLAYS

CCD map display

CONTROLS

CCD function keys
Cursor control
CCD touch panel

Task Element Number 2.05

TASK ELEMENT TITLE: Determine Own Unit Situation

DISPLAYS

CITV display
Commander's cupola vision blocks

CONTROLS

CITV function switches
CCD function keys
Commander's control handle

Task Element Number 2.06

TASK ELEMENT TITLE: Correct Report Data

DISPLAYS

CCD display
CCD map display
CITV display
Commander's cupola vision blocks
IFF display

CONTROLS

CCD function keys
CITV function switches
Commander's control handle
Cursor control
Laser rangefinder

Task Element Number 2.07

TASK ELEMENT TITLE: Determine Correct Routing

DISPLAYS

CCD display

CONTROLS

CCD function keys

Task Element Number 2.08

TASK ELEMENT TITLE: Enter Report Data to Map Display

DISPLAYS

- CCD map display
- CITV display
- Commander's cupola vision blocks
- IFF display

CONTROLS

- CCD function keys
- CITV function switches
- Commander's control handle
- Laser rangfinder
- Cursor control

Task Element Number 2.09

TASK ELEMENT TITLE: Transmit Report

DISPLAYS

- CCD display

CONTROLS

- CCD function keys
- Cursor control

CVCC TASK AND TASK ELEMENT DATA FORM

Task Number 3

TASK TITLE: Prepare and Submit Shell Report Using CCD

DUTY POSITION

Company Commander
Platoon Leader
Platoon Sergeant
Tank Commander

CONDITIONS

Tactical or nontactical situation under all weather conditions
All types of terrain
May be performed in an NBC environment
M1A2 tank, simulator or stand alone situation
Use PDEP 9-2350-264-10-1 (M1A2)

PERFORMANCE MEASURES

Report generation time
Report accuracy
Report completeness

INITIATING CUES

Receive shelling
Sight shelling

TERMINATING CUES

Report Sent message appears on CCD display

FEEDBACK CUES

Units respond to shelling by taking cover
Units avoid shelling area

DEFENSIVE FREQUENCY

Frequently - several times per mission

OFFENSIVE FREQUENCY

Frequently - several times per mission

CRITICALITY 9.30%

9.3 percent of the workload respondents ranked this task as their top priority task.

LEARNING DIFFICULTY
Somewhat below average

REASON FOR DIFFICULTY
Simultaneous tasks

DATA SOURCE
CVCC exercise observations
Workload data analysis

COMMENTS
None

SKILLS
Touch screen cursor control
Commander's control handle and cursor

KNOWLEDGE
Indicators of a shelling
Friendly or enemy shelling

PERFORMANCE TIME: 1 minute, 0 seconds

Task Element Number 3.01

TASK ELEMENT TITLE: Operate CCD Function Keys

DISPLAYS
CCD display

CONTROLS
CCD function keys
Cursor control

Task Element Number 3.02

TASK ELEMENT TITLE: Identify Shelling

DISPLAYS
CITV display
Commander's cupola vision blocks

CONTROLS
CITV function switches

Task Element Number 3.03

TASK ELEMENT TITLE: Operate Laser Rangefinder

DISPLAYS

CITV display
IFF display

CONTROLS

Commander's control handle
CITV function switches

Task Element Number 3.04

TASK ELEMENT TITLE: Select Correct Report Routing

DISPLAYS

CCD map display

CONTROLS

CCD function keys

Task Element Number 3.05

TASK ELEMENT TITLE: Transmit Report

DISPLAYS

CCD display

CONTROLS

CCD function keys
Cursor control

CVCC TASK AND TASK ELEMENT DATA FORM

Task Number 4

TASK TITLE: Prepare and Submit Contact Report Using CCD

DUTY POSITION

Company Commander
Platoon Leader
Platoon Sergeant
Tank Commander

CONDITIONS

Tactical or nontactical situation under all weather conditions
All types of terrain
May be performed in an NBC environment
M1A2 tank, simulator or stand alone situation
Use PDEP 9-2350-264-10-1 (M1A2)

PERFORMANCE MEASURES

Report generation time
Report accuracy
Report completeness

INITIATING CUES

Initial visual contact
Receive direct fire
Receive indirect fire
Receive air attack

TERMINATING CUES

Report Sent message appears on display

FEEDBACK CUES

Additional information requested
Another tank assists sender in engagement or some function related to report sent

DEFENSIVE FREQUENCY

Frequently - several times per mission

OFFENSIVE FREQUENCY

Frequently - several times per mission

CRITICALITY 33.50%

33.5 percent of the workload respondents ranked this task as their top priority task.

LEARNING DIFFICULTY

Average

REASONS FOR DIFFICULTY

Limited time
Simultaneous tasks

DATA SOURCE

Tank platoon SOP
FKSM 17-15-3, dtd Feb 1989
CVCC exercise observations
Workload data analysis

COMMENTS

In the CVCC experiment, it was noted that the method selected in performing the task was dependent on the situation. The shorter method of making a contact report was more evident in an offensive scenario (e.g., movement to contact) whereas a more time consuming method was utilized during a defensive scenario (e.g., delay).

SKILLS

Touch screen cursor control
Commander's control handle in conjunction with CITV

KNOWLEDGE

Identify enemy units
Differences in enemy unit activities
Priority in routing report

PERFORMANCE TIME: 1 minute, 0 seconds

Task Element Number 4.01

TASK ELEMENT TITLE: Operate CCD Function Keys

DISPLAYS

CCD display

CONTROLS

CCD function keys
Cursor control

Task Element Number 4.02

TASK ELEMENT TITLE: Determine Enemy Unit Type

DISPLAYS

CITV display
Commander's cupola vision blocks
IFF display

CONTROLS

CITV function switches
CCD function keys
Commander's control handle

Task Element Number 4.03

TASK ELEMENT TITLE: Operate Laser Rangefinder to Determine Enemy Location

DISPLAYS

CITV display
IFF display

CONTROLS

Commander's control handle
CITV function switches

Task Element Number 4.04

TASK ELEMENT TITLE: Designate Enemy Location with Map Display

DISPLAYS

CCD map display

CONTROLS

CCD function keys
Cursor control

Task Element Number 4.05

TASK ELEMENT TITLE: Select Routing Priority

DISPLAYS

CCD display

CONTROLS

CCD function keys

Task Element Number 4.06

TASK ELEMENT TITLE: Enter Report Data on Map Display

DISPLAYS

CCD map display
CITV display
Commander's cupola vision blocks
IFF display

CONTROLS

CCD function keys
CITV function switches
Commander's control handle
Laser rangefinder
Cursor control

Task Element Number 4.07

TASK ELEMENT TITLE: Transmit Report

DISPLAY

CCD display

CONTROLS

CCD function keys
Cursor control

CVCC TASK AND TASK ELEMENT DATA FORM

Task Number 5

TASK TITLE: Prepare and Submit Call for Fire Report Using CCD

DUTY POSITION

Company Commander
Platoon Leader
Platoon Sergeant
Tank Commander

CONDITIONS

Tactical or nontactical situation under all weather conditions
All types of terrain
May be performed in an NBC environment
M1A2 tank, simulator or stand alone situation
Use PDEP 9-2350-264-10-1 (M1A2)

PERFORMANCE MEASURES

Report generation time
Report accuracy
Report completeness

INITIATING CUES

Suspected enemy positions
Enemy force attacking
Enemy force large

TERMINATING CUES

Fire support received
Enemy destroyed

FEEDBACK CUES

Accuracy of fire support

DEFENSIVE FREQUENCY

Frequently - several times per mission

OFFENSIVE FREQUENCY

Frequently - several times per mission

CRITICALITY 7.50%

7.5 percent of the workload respondents ranked this task as their top priority task.

LEARNING DIFFICULTY

Average

REASONS FOR DIFFICULTY

Simultaneous tasks

DATA SOURCE

CVCC exercise observations
Workload data analysis

COMMENTS

None

SKILLS

Manipulate use of display cursor
Use laser rangefinder

KNOWLEDGE

Call for fire procedures
Methods for estimating adjustments
System automated capabilities

PERFORMANCE TIME: 1 minute, 30 seconds

Task Element Number 5.01

TASK ELEMENT TITLE: Operate CCD Function Keys

DISPLAYS

CCD display
CCD map display

CONTROLS

CCD function keys

Task Element Number 5.02

TASK ELEMENT TITLE: Operate Laser Rangefinder to Determine Enemy Location

DISPLAYS

CITV display
IFF display

CONTROLS

CITV function switches
Commander's control handle

Task Element Number 5.03

TASK ELEMENT TITLE: Operate Map Display to Determine Enemy Location

DISPLAYS

CCD map display

CONTROLS

CCD function keys
Cursor control

Task Element Number 5.04

TASK ELEMENT TITLE: Determine Add/Drop Shifts for Adjust Fire

DISPLAYS

CCD display

CONTROLS

CCD display keyboard

Task Element Number 5.05

TASK ELEMENT TITLE: Select Correct Report Routing

DISPLAYS

CCD display

CONTROLS

CCD function keys

Task Element Number 5.06

TASK ELEMENT TITLE: Enter Data to Map Display

DISPLAYS

- CCD map display
- CITV display
- Commander's cupola vision blocks
- IFF display

CONTROLS

- CCD function keys
- CITV function switches
- Commander's control handle
- Laser rangefinder
- Cursor control

Task Element Number 5.07

TASK ELEMENT TITLE: Transmit Report

DISPLAY

- CCD display

CONTROLS

- CCD function keys
- Cursor control

CVCC TASK AND TASK ELEMENT DATA FORM

Task Number 6

TASK TITLE: Prepare and Submit SITREP Report Using CCD

DUTY POSITION

Company Commander
Platoon Leader
Platoon Sergeant
Tank Commander

CONDITIONS

Tactical or nontactical situation under all weather conditions
All types of terrain
May be performed in an NBC environment
M1A2 tank, simulator or stand alone situation
Use PDEP 9-2350-264-10-1 (M1A2)

PERFORMANCE MEASURES

Report generation time
Report accuracy
Report completeness

INITIATING CUES

After a significant event
Battle position changes
Consolidation on objective
Requested by higher headquarters

TERMINATING CUES

Report Sent message appears on CCD display

FEEDBACK CUES

Additional information requested
CCD display indicates message sent

DEFENSIVE FREQUENCY

Continuously - all during the mission

OFFENSIVE FREQUENCY

Frequently - several times per mission

CRITICALITY 13.30%

13.3 percent of the workload respondents ranked this task as their top priority task.

LEARNING DIFFICULTY

Average

REASONS FOR DIFFICULTY

Simultaneous tasks

DATA SOURCE

CVCC exercise observations
Workload data analysis
Tank platoon SOP
FKSM 17-15-3, dtd Feb 1989

COMMENTS

The SITREP report is not difficult to complete but due to circumstances at the time a request for a SITREP may be delayed. The first thing of importance to the TC is to conduct combat operations.

SKILLS

Touch screen cursor control
Commander's control handle cursor control

KNOWLEDGE

Know when report is required
Know what FLOT end points are
How to calculate FLOT end points
Know commander's intent
Know what various reporting status terms mean (red, green, amber, etc.)

PERFORMANCE TIME: 2 minutes, 0 seconds

Task Element Number 6.01

TASK ELEMENT TITLE: Operate CCD Function Keys

DISPLAYS

CCD display
CCD map display

CONTROLS

CCD function keys

Task Element Number 6.02

TASK ELEMENT TITLE: Operate Laser Rangefinder to Determine FLOT End Points

DISPLAYS

CITV display

CONTROLS

Commander's control handle
CCD map touch panel
Laser rangefinder

Task Element Number 6.03

TASK ELEMENT TITLE: Operate Map Display

DISPLAYS

CCD map display
CCD display

CONTROLS

CCD function keys
Cursor control

Task Element Number 6.04

TASK ELEMENT TITLE: Select Enemy Activity and Type

DISPLAYS

CITV display
Commander's cupola vision blocks
IFF display

CONTROLS

CITV function switches
CCD function keys
Commander's control handle

Task Element Number 6.05

TASK ELEMENT TITLE: Select Critical Shortages

DISPLAYS
CCD display

CONTROLS
CCD function keys

Task Element Number 6.06

TASK ELEMENT TITLE: Select Commander's Intent

DISPLAYS
CCD display

CONTROLS
CCD function keys

Task Element Number 6.07

TASK ELEMENT TITLE: Correct Report Data

DISPLAYS
CCD display
CCD map display
CITV display
Commander's cupola vision blocks
IFF display

CONTROLS
CCD function keys
CITV function switches
Commander's control handle
Laser rangefinder
Cursor control

Task Element Number 6.08

TASK ELEMENT TITLE: Select Report Routing

DISPLAY
CCD display

CONTROLS
CCD function keys

Task Element Number 6.09

TASK ELEMENT TITLE: Transmit Report

DISPLAY
CCD display

CONTROLS
CCD function keys
Cursor control

CVCC TASK AND TASK ELEMENT DATA FORM

Task Number 7

TASK TITLE: Prepare and Submit NBC Report Using CCD

DUTY POSITION

Company Commander
Platoon Leader
Platoon Sergeant
Tank Commander

CONDITIONS

Tactical or nontactical situation under all weather conditions
All types of terrain
May be performed in an NBC environment
M1A2 tank, simulator or stand alone situation
Use PDEP 9-2350-264-10-1 (M1A2)

PERFORMANCE MEASURES

Report generation time
Report accuracy
Report completeness

INITIATING CUES

Chemical agent detected
Mist appears after artillery attack
Color changes M8/M9 paper
Chemical agent alarm
Individual agent symptom
Dose rate 1 CGY per hr
Observed mushroom cloud

TERMINATING CUES

Report Sent message appears on CCD display
All clear signal is received

FEEDBACK CUES

Units avoid contaminated area
Message sent indicated on CCD display
All clear signal is received

DEFENSIVE FREQUENCY

Regularly - Once per mission

OFFENSIVE FREQUENCY
Regularly - Once per mission

CRITICALITY 2.20%
2.2 percent of the workload respondents ranked this task as their top priority task.

LEARNING DIFFICULTY
Somewhat above average

REASONS FOR DIFFICULTY
Simultaneous tasks
Anxiety
Weak in knowledge of NBC operations

DATA SOURCE
CVCC exercise observations
Workload data analysis
Tank platoon SOP
FKSM 17-15-3, dtd Feb 1989

COMMENTS
Not sure of reasons for low ranking of task among test respondents. It may be due to the infrequent performance of this task during a mission. The report menus used to complete this automated report are not as friendly as other automated reports in the system.

SKILLS
Touch screen cursor control
Commander's control handle cursor control
Use of laser rangefinders

KNOWLEDGE
Know basic NBC reporting methods
Know tactical procedures involving an NBC environment

PERFORMANCE TIME: 2 minutes, 0 seconds

Task Element Number 7.01

TASK ELEMENT TITLE: Operate CCD Function Keys

DISPLAYS

CCD display

CONTROLS

CCD function keys
Cursor control

Task Element Number 7.02

TASK ELEMENT TITLE: Operate Laser Rangefinder to Obtain Attack Location

DISPLAYS

CITV display
IFF display

CONTROLS

CITV function keys
Commander's control handle

Task Element Number 7.03

TASK ELEMENT TITLE: Operate Map Display

DISPLAYS

CCD map display
CCD display

CONTROLS

CCD function keys
Cursor control

Task Element Number 7.04

TASK ELEMENT TITLE: Select Type of Burst and Attack

DISPLAYS

CCD display

CONTROLS

CCD function keys

Task Element Number 7.05

TASK ELEMENT TITLE: Select Nuclear Burst Data

DISPLAYS

CCD display

CONTROLS

CCD function keys

Task Element Number 7.06

TASK ELEMENT TITLE: Correct Report Data

DISPLAYS

CCD display
CCD map display
CITV display
Commander's cupola vision blocks
IFF display

CONTROLS

CCD function keys
CITV function switches
Commander's control handle
Laser rangefinder
Cursor control

Task Element Number 7.07

TASK ELEMENT TITLE: Select Report Routing

DISPLAY
CCD display

CONTROLS
CCD function keys

Task Element Number 7.08

TASK ELEMENT TITLE: Enter Data to Map Display

DISPLAY
CCD map display
CITV display
Commander's cupola vision Blocks

CONTROLS
CCD function keys
Cursor control
CITV function switches
Commander's control handle
Laser rangefinder

Task Element Number 7.09

TASK ELEMENT TITLE: Transmit Report

DISPLAY
CCD display

CONTROLS
CCD function keys
Cursor control

CVCC TASK AND TASK ELEMENT DATA FORM

Task Number 8

TASK TITLE: Designate and Transmit Route Coordinates Using CCD

DUTY POSITION

Company Commander
Platoon Leader
Platoon Sergeant
Tank Commander

CONDITIONS

Tactical or nontactical situation under all weather conditions
All types of terrain
May be performed in an NBC environment
M1A2 tank, simulator or stand alone situation
Use PDEP 9-2350-264-10-1 (M1A2)

PERFORMANCE MEASURES

Report generation time
Report accuracy
Report completeness
Waypoint coordinate accuracy
Sector control
Distance traveled
Misorientation
Boundary violation
Route deviation
Vehicle speed over time
Mission planning procedures

INITIATING CUES

Mission planning meeting
Receive OPORD to move
Receive FRAGO

TERMINATING CUES

Objective accomplished
Change in mission

FEEDBACK CUES

Objective accomplished
Units respond in maintaining course

DEFENSIVE FREQUENCY

Frequently - Several times per mission

OFFENSIVE FREQUENCY

Continuously - All during the mission

CRITICALITY 37.40%

37.4 percent of the workload respondents ranked this task as their top priority task. Actual task ranked was entitled Direct Actions of Driver. This task refers to an automated capability that enables the tank commander to direct actions of the driver. This capability minimizes voice communications.

LEARNING DIFFICULTY

Somewhat above average

REASONS FOR DIFFICULTY

Lack of basic map reading and procedures
Weak in tactical movement requirements
Simultaneous tasks

DATA SOURCE

CVCC exercise observations
Workload data analysis

COMMENTS

This task normally involves considerable communication between the tank commander and the driver. Having the capability to designate a route for the driver with occasional reports from the driver on reaching a waypoint frees the TC to do other tasks. The burden of assisting the driver is reduced considerably through this automated capability. The test respondents listed the task of directing the driver as a high priority task.

SKILLS

Touch screen cursor control
Commander's control handle cursor control
Read a map
Basic map skills

KNOWLEDGE

Know movement tactical procedures
Know terrain features

PERFORMANCE TIME: 5 minutes, 0 seconds

Task Element Number 8.01

TASK ELEMENT TITLE: Operate CCD Function Keys

DISPLAYS

CCD display

CONTROLS

CCD function keys
Cursor control

Task Element Number 8.02

TASK ELEMENT TITLE: Designate Waypoint Coordinates on Map Display

DISPLAYS

CCD map display
CCD display

CONTROLS

CCD function keys
Cursor control

Task Element Number 8.03

TASK ELEMENT TITLE: Delete or Change Waypoints

DISPLAYS

CCD map display
CCD display

CONTROLS

CCD function keys
Cursor control

Task Element Number 8.04

TASK ELEMENT TITLE: Transmit Waypoints to Driver

DISPLAYS
CCD display

CONTROLS
CCD function keys
Cursor control

Task Element Number 8.05

TASK ELEMENT TITLE: Retain Waypoint Coordinates in Memory

DISPLAYS
CCD display

CONTROLS
CCD function keys

Task Element Number 8.06

TASK ELEMENT TITLE: Transmit Waypoints to Other Units

DISPLAYS
CCD display

CONTROLS
CCD function keys

CVCC TASK AND TASK ELEMENT DATA FORM

Task Number 9

TASK TITLE: Receive and Review Route Coordinates Using CCD

DUTY POSITION

Company Commander
Platoon Leader
Platoon Sergeant
Tank Commander

CONDITIONS

Tactical or nontactical situation under all weather conditions
All types of terrain
May be performed in an NBC environment
M1A2 tank, simulator or stand alone situation
Use PDEP 9-2350-264-10-1 (M1A2)

PERFORMANCE MEASURES

Completeness

INITIATING CUES

Radio communication that route has been sent
Receive Light illuminated
Receipt of an overlay

TERMINATING CUES

Use route as active route
Delete route from memory
Save route in memory

FEEDBACK CUES

Route is displayed on CCD map display

DEFENSIVE FREQUENCY

Regularly - Once per mission

OFFENSIVE FREQUENCY

Regularly - Once per mission

CRITICALITY 0.00%
Not available for this task.

LEARNING DIFFICULTY
Somewhat below average

REASONS FOR DIFFICULTY
None

DATA SOURCE
CVCC exercise observations
Workload data analysis
Task analysis

COMMENTS
This is a short, easy task to perform and could be embedded in the main task with which it is associated, Designate and Transmit Route Coordinates Using the CCD. Could change task to read "Designate, Transmit and Receive Route Coordinates Using the CCD."

SKILLS
Touch screen cursor control
Commander's control handle cursor control

KNOWLEDGE
Function keys
Queue/file differences
Message alerts
Display map and route designation association

PERFORMANCE TIME: 1 minutes, 0 seconds

Task Element Number 9.01

TASK ELEMENT TITLE: Operate CCD Function Keys

DISPLAYS
CCD display

CONTROLS
CCD function keys
Cursor control

Task Element Number 9.02

TASK ELEMENT TITLE: Select Route from Route File

DISPLAYS
- CCD map display
- CCD display

CONTROLS
- CCD function keys
- Cursor control

Task Element Number 9.03

TASK ELEMENT TITLE: Designate Route as Active Route for System

DISPLAYS
- CCD map display
- CCD display

CONTROLS
- CCD function keys
- Cursor control

Task Element Number 9.04

TASK ELEMENT TITLE: Delete Route File

DISPLAYS
- CCD display

CONTROLS
- CCD function keys
- Cursor control

Task Element Number 9.05

TASK ELEMENT TITLE: Exit Route File Menu

DISPLAYS
- CCD display

CONTROLS
- CCD function keys

CVCC TASK AND TASK ELEMENT DATA FORM

Task Number 10

TASK TITLE: Prepare and Submit Adjust Fire Report Using CCD

DUTY POSITION

Company Commander
Platoon Leader
Platoon Sergeant
Tank Commander

CONDITIONS

Tactical or nontactical situation under all weather conditions
All types of terrain
May be performed in an NBC environment
M1A2 tank, simulator or stand alone situation
Use PDEP 9-2350-264-10-1 (M1A2)

PERFORMANCE MEASURES

Report generation time
Report completeness
Report accuracy

INITIATING CUES

Suspected enemy positions
Enemy force attacking
Enemy force large

TERMINATION CUES

Fire support received
Enemy destroyed

FEEDBACK CUES

Enemy destroyed

DEFENSE FREQUENCY

Frequently - Several times per mission

OFFENSE FREQUENCY

Frequently - Several times per mission

CRITICALITY 7.50%

7.5 percent of the workload respondents ranked Prepare and Submit CFF Report as their top priority task. A component of this task is Prepare and Submit Adjust Fire Report using the CCD.

LEARNING DIFFICULTY

Somewhat below average

REASONS FOR DIFFICULTY

None

DATA SOURCE

CVCC exercise observations
Workload data analysis
Task analysis

COMMENTS

This task, although a separate function of the CCD device, basically functions the same as the "Call for Fire" report. In fact, it is an extraction from the basic report.

SKILLS

Touch screen cursor control
Commander's control handle cursor control
Laser rangefinder

KNOWLEDGE

Call for fire procedures
Calculate differences in shell impact to target location
Understand system automated capabilities

PERFORMANCE TIME: 1 minutes, 0 seconds

Task Element Number 10.01

TASK ELEMENT TITLE: Operate CCD Function Keys

DISPLAYS

CCD display
CCD map display

CONTROLS

CCD function keys

Task Element Number 10.02

TASK ELEMENT TITLE: Operate CITV Function Switches

DISPLAYS
CITV display

CONTROLS
CITV function switches
Commander's control handle

Task Element Number 10.03

TASK ELEMENT TITLE: Operate Laser Rangefinder to Determine Target Location

DISPLAYS
CITV display
IFF display

CONTROLS
CITV function switches
Commander's control handle

Task Element Number 10.04

TASK ELEMENT TITLE: Operate Map Display

DISPLAYS
CCD map display
CCD display

CONTROLS
CCD function keys
Cursor control

Task Element Number 10.05

TASK ELEMENT TITLE: Enter Add/Drop Shifts for Target Location

DISPLAYS
CCD display

CONTROLS
CCD display keyboard

Task Element Number 10.06

TASK ELEMENT TITLE: Select Report Routing

DISPLAYS

CCD display

CONTROLS

CCD function keys
Cursor control

Task Element Number 10.07

TASK ELEMENT TITLE: Enter Data to Map Display

DISPLAYS

CCD map display
CITV display
Commander's cupola vision blocks
IFF display

CONTROLS

CCD function keys
CITV function switches
Commander's control handle
Laser rangefinder
Cursor control

Task Element Number 10.08

TASK ELEMENT TITLE: Transmit Report

DISPLAYS

CCD display

CONTROLS

CCD function keys
Cursor control

CVCC TASK AND TASK ELEMENT DATA FORM

Task Number 11

TASK TITLE: Prepare and Submit Ammunition Report Using CCD

DUTY POSITION

Company Commander
Platoon Leader
Platoon Sergeant
Tank Commander

CONDITIONS

Tactical or nontactical situation under all weather conditions
All types of terrain
May be performed in an NBC environment
M1A2 tank, simulator or stand alone situation
Use PDEP 9-2350-264-10-1 (M1A2)

PERFORMANCE MEASURES

Report generation time
Report completeness
Report accuracy

INITIATION CUES

Completed a mission
Completed fire fight
Requested by higher headquarters

TERMINATION CUES

Report Sent message displayed on CCD display

FEEDBACK CUES

Additional information requested
Sent message on CCD display

DEFENSIVE FREQUENCY

Frequently - Several times per mission

OFFENSIVE FREQUENCY

Frequently - Several times per mission

CRITICALITY 0.00%
Not available for this task

LEARNING DIFFICULTY
Low

REASONS FOR DIFFICULTY
None

DATA SOURCE
CVCC exercise observations
Tank platoon SOP
FKSM 17-15-3, dtd Feb 1989

COMMENTS
The ammo report is a fairly easy report to complete

SKILLS
Operate display cursor
Operate Commander's control handle cursor

KNOWLEDGE
Know different types of ammo used
Know when report is required by SOP

PERFORMANCE TIME: 1 minutes, 0 seconds

Task Element Number 11.01

TASK ELEMENT TITLE: Operate CCD Function Keys

DISPLAYS
CCD display
CCD map display

CONTROLS
CCD function keys

Task Element Number 11.02

TASK ELEMENT TITLE: Determine Ammo Status

DISPLAYS
CCD display

CONTROLS
CCD function keys
Cursor control

Task Element Number 11.03

TASK ELEMENT TITLE: Select Report Routing

DISPLAYS
CCD display

CONTROLS
CCD function keys
Cursor control

Task Element Number 11.04

TASK ELEMENT TITLE: Transmit Report

DISPLAYS
CCD display

CONTROLS
CCD function keys
Cursor control

CVCC TASK AND TASK ELEMENT DATA FORM

Task Number 12

TASK TITLE: Prepare and Submit Intelligence Report Using CCD

DUTY POSITION

Company Commander
Platoon Leader
Platoon Sergeant
Tank Commander

CONDITIONS

Tactical or nontactical situation under all weather conditions
All types of terrain
May be performed in an NBC environment
M1A2 tank, simulator or stand alone situation
Use PDEP 9-2350-264-10-1 (M1A2)

PERFORMANCE MEASURES

Report generation time
Report completeness
Report accuracy

INITIATION CUES

Enemy units observed
Obstacles observed

TERMINATION CUES

Report Sent message displayed on CCD display

FEEDBACK CUES

Message sent on CCD display
Friendly units attack
Artillery destroys enemy target

DEFENSE FREQUENCY

Frequently - Several times per mission

OFFENSE FREQUENCY

Frequently - Several times per mission

CRITICALITY 0.00%
Not available for this task

LEARNING DIFFICULTY
Average

REASONS FOR DIFFICULTY
Simultaneous task

DATA SOURCE
CVCC exercise observations
Tank platoon SOP
FKSM 17-15-3, dtd Feb 1989

COMMENTS
None

SKILLS
Touch screen cursor control
Commander's control handle cursor

KNOWLEDGE
Know different enemy vehicles
Know how to spot obstacles

PERFORMANCE TIME: 1 minutes, 30 seconds

Task Element Number 12.01

TASK ELEMENT TITLE: Operate CCD Function Keys

DISPLAYS
CCD display

CONTROLS
CCD function keys
Cursor control

Task Element Number 12.02

TASK ELEMENT TITLE: Select Unit and Obstacle Type

DISPLAYS
CCD display

CONTROLS
CCD function keys
Cursor control

Task Element Number 12.03

TASK ELEMENT TITLE: Operate CITV Function Switches

DISPLAYS
CITV display

CONTROLS
CITV function switches
Commander's control handle

Task Element Number 12.04

TASK ELEMENT TITLE: Operate Laser Rangefinders to Determine Location

DISPLAYS
CITV display
IFF display

CONTROLS
CITV function switches
Commander's control handle

Task Element Number 12.05

TASK ELEMENT TITLE: Operate Map Display to Determine Location

DISPLAY
CCD map display

CONTROLS
CCD function keys
Cursor control

Task Element Number 12.06

TASK ELEMENT TITLE: Select Unit Activity and Heading

DISPLAYS

- CITV display
- CCD map display
- CCD display
- Commander's cupola vision blocks
- IFF display

CONTROLS

- CITV function switches
- CCD function keys
- Commander's control handle

Task Element Number 12.07

TASK ELEMENT TITLE: Correct Report Data

DISPLAYS

- CCD display
- CCD map display
- CITV display
- Commander's cupola vision blocks
- IFF display

CONTROLS

- CCD function keys
- CITV function switches
- Commander's control handle
- Cursor control
- Laser rangefinder

Task Element Number 12.08

TASK ELEMENT TITLE: Select Report Routing

DISPLAY

- CCD display

CONTROLS

- CCD function keys
- Cursor control

Task Element Number 12.09

TASK ELEMENT TITLE: Transmit Report

DISPLAY

CCD display

CONTROLS

CCD function keys
Cursor control

CVCC TASK AND TASK ELEMENT DATA FORM

Task Number 13

TASK TITLE: Receive, Review and Retransmit FRAGO Report Using CCD

DUTY POSITION

Company Commander
Platoon Leader
Platoon Sergeant
Tank Commander

CONDITIONS

Tactical or nontactical situation under all weather conditions
All types of terrain
May be performed in an NBC environment
M1A2 tank, simulator or stand alone situation
Use PDEP 9-2350-264-10-1 (M1A2)

PERFORMANCE MEASURES

Receive report
Retransmit report

INITIATION CUES

Receive key is highlighted
Communication that FRAGO was sent

TERMINATION CUES

FRAGO displayed on map display
FRAGO Sent message appears on CCD display

FEEDBACK CUES

FRAGO is displayed on CCD map display
FRAGO Sent message on CCD display

DEFENSE FREQUENCY

Regularly - Once per mission

OFFENSE FREQUENCY

Seldom - Every few missions

CRITICALITY 0.00%

Not available for this task

LEARNING DIFFICULTY
Average

REASONS FOR DIFFICULTY
Simultaneous task

DATA SOURCE
CVCC exercise observation
Task analysis

COMMENTS
None

SKILLS
Operate touch screen cursor on CCD display
Operate control handle cursor control

KNOWLEDGE
Know map size function
Know automated capabilities of system

PERFORMANCE TIME: 2 minutes, 0 seconds

Task Element Number 13.01

TASK ELEMENT TITLE: Operate CCD Function Keys

DISPLAYS
CCD display

CONTROLS
CCD function keys
Cursor control

Task Element Number 13.02

TASK ELEMENT TITLE: Select FRAGO Message

DISPLAYS
CCD display

CONTROLS
CCD function keys
Cursor control

Task Element Number 13.03

TASK ELEMENT TITLE: Post FRAGO to Map Display

DISPLAYS

CCD display
CCD map display

CONTROLS

CCD function keys
Cursor control

Task Element Number 13.04

TASK ELEMENT TITLE: Retransmit FRAGO to Other Units

DISPLAYS

CCD display
CCD map display

CONTROLS

CCD function keys
Cursor control

CVCC TASK AND TASK ELEMENT DATA FORM

Task Number 14

TASK TITLE: Search for Targets Using the CITV

DUTY POSITION
Company Commander
Platoon Leader
Platoon Sergeant
Tank Commander

CONDITIONS
Tactical or nontactical situation under all weather conditions
All types of terrain
May be performed in an NBC environment
M1A2 tank, simulator or stand alone situation
Use PDEP 9-2350-264-10-1 (M1A2)

PERFORMANCE MEASURES
Percent targets detected and reported

INITIATION CUES
Begin tactical movement
In defensive position

TERMINATION CUES
Target detected

FEEDBACK CUES
Target detected & identified as enemy on CITV display

DEFENSE FREQUENCY
Frequently - Several times per mission

OFFENSE FREQUENCY
Continuously - All during the mission

CRITICALITY 0.00%
Not available for this task

LEARNING DIFFICULTY
Average

REASONS FOR DIFFICULTY

Simultaneous task
Decision on which mode (manual or auto) to search dependent on situation (i.e., offensive or defensive mission)

DATA SOURCE

CVCC exercise observation

COMMENTS

None

SKILLS

Operate Commander's control handle in conjunction with CITV

KNOWLEDGE

Know what azimuth and elevation are
How to compute azimuth and elevation
Function of CITV

PERFORMANCE TIME: 3 minutes, 0 seconds

Task Element Number 14.01

TASK ELEMENT TITLE: Operate CITV Function Switches and Controls

DISPLAYS

CITV display

CONTROLS

CITV function switches

Task Element Number 14.02

TASK ELEMENT TITLE: Operate CITV in Auto Scan Mode

DISPLAYS

CITV display

CONTROLS

CITV function keys
Commander's control handle

Task Element Number 14.03

TASK ELEMENT TITLE: Operate CITV in Manual Search Mode

DISPLAYS

CITV display

CONTROLS

CITV function keys
Commander's control handle

Task Element Number 14.04

TASK ELEMENT TITLE: Operate CITV in Gun Line of Sight (GLOS) Search Mode

DISPLAYS

CITV display

CONTROLS

CITV function keys

CVCC TASK AND TASK ELEMENT DATA FORM

Task Number 15

TASK TITLE: Identify and Prioritize Targets Using CITV

DUTY POSITION

Company Commander
Platoon Leader
Platoon Sergeant
Tank Commander

CONDITIONS

Tactical or nontactical situation under all weather conditions
All types of terrain
May be performed in an NBC environment
M1A2 tank, simulator or stand alone situation
Use PDEP 9-2350-264-10-1 (M1A2)

PERFORMANCE MEASURES

Targets identified and prioritized
Judgment
Decisivness
Cognitive ability

INITIATION CUES

Target detected
Enemy sighted

TERMINATION CUES

Target identification

FEEDBACK CUES

Confirmation by other tanks in area

DEFENSE FREQUENCY

Frequently - Several times per mission

OFFENSE FREQUENCY

Continuously - All during the mission

CRITICALITY 25.10%

25.1 percent of the workload respondents ranked this task as their top priority task.

LEARNING DIFFICULTY

Somewhat above average

REASONS FOR DIFFICULTY

Simultaneous tasks

IFF detection is built on a table of probability rather than actual IFF transponder capabilities. Target stack capability may not receive enough emphasis during training. The tank commander is more inclined to use this capability during a defensive mission than an offensive mission due to time constraints.

DATA SOURCE

CVCC exercise observation

Workload data analysis

COMMENTS

This task consists of two parts: (a) the identification of the targets, and (b) the prioritization of the targets.

SKILLS

Operate control handle in conjuction with CITV

Operate laser rangefinder

KNOWLEDGE

IFF detection

Engagement procedures

Threat conditions

PERFORMANCE TIME: 3 minutes, 0 seconds

Task Element Number 15.01

TASK ELEMENT TITLE: Target Detection

DISPLAYS

CITV display

IFF display

CONTROLS

CITV function switches

Commander's control handle

Task Element Number 15.02

TASK ELEMENT TITLE: Operate CITV Function Switches and Controls

DISPLAYS
CITV display

CONTROLS
CITV function switches
Commander's control handle

Task Element Number 15.03

TASK ELEMENT TITLE: Operate CITV Laser Rangefinder

DISPLAYS
CITV display
IFF display

CONTROLS
CITV function switches
Commander's control handle

Task Element Number 15.04

TASK ELEMENT TITLE: IFF Designation

DISPLAYS
CITV display
IFF display

CONTROLS
CITV display
Commander's control handle

Task Element Number 15.05

TASK ELEMENT TITLE: Prioritization of Targets

DISPLAYS
CITV display

CONTROLS
CITV function switches

Task Element Number 15.06

TASK ELEMENT TITLE: Engagement of Targets in Target Queue

DISPLAYS

CITV display
IFF display
Commander's cupola vision blocks

CONTROLS

CITV function switches
Gunner's function switches
Commander's control handle

CVCC TASK AND TASK ELEMENT DATA FORM

Task Number 16

TASK TITLE: Control Map Display Functions Using CCD

DUTY POSITION

Company Commander
Platoon Leader
Platoon Sergeant
Tank Commander

CONDITIONS

Tactical or nontactical situation under all weather conditions
All types of terrain
May be performed in an NBC environment
M1A2 tank, simulator or stand alone situation
Use PDEP 9-2350-264-10-1 (M1A2)

PERFORMANCE MEASURES

Terrain identification
Determining coordinates

INITIATION CUES

Target detected
Enemy sighted

TERMINATION CUES

Map overlay not visible on display
Overlay partially visible
Terrain features missing

FEEDBACK CUES

Overlay is visible on CCD display
Terrain features are present on display

DEFENSE FREQUENCY

Frequently - Several times per mission

OFFENSE FREQUENCY

Regularly - Once per mission

CRITICALITY 0.00%
Not available for this task

LEARNING DIFFICULTY
Average

REASONS FOR DIFFICULTY
Selection of appropriate map size
Positioning of overlay on CCD map display

DATA SOURCE
CVCC exercise observation
Task analysis

COMMENTS
None

SKILLS
Operate CCD cursor control

KNOWLEDGE
Know different map sizes
Understand scrolling function

PERFORMANCE TIME: 1 minute, 30 seconds

Task Element Number 16.01

TASK ELEMENT TITLE: Operate CCD Function Keys

DISPLAYS
CCD display

CONTROLS
CCD function keys

Task Element Number 16.02

TASK ELEMENT TITLE: Store Overlays in Memory

DISPLAYS
CCD display
CCD map display

CONTROLS
CCD function keys

Task Element Number 16.03

TASK ELEMENT TITLE: Delete Overlays from Map Display and Memory

DISPLAYS
CCD display
CCD map display

CONTROLS
CCD function keys

Task Element Number 16.04

TASK ELEMENT TITLE: Set Up Map Display Features

DISPLAYS
CCD display
CCD map display

CONTROLS
CCD function keys

Task Element Number 16.05

TASK ELEMENT TITLE: Exit Map Menu

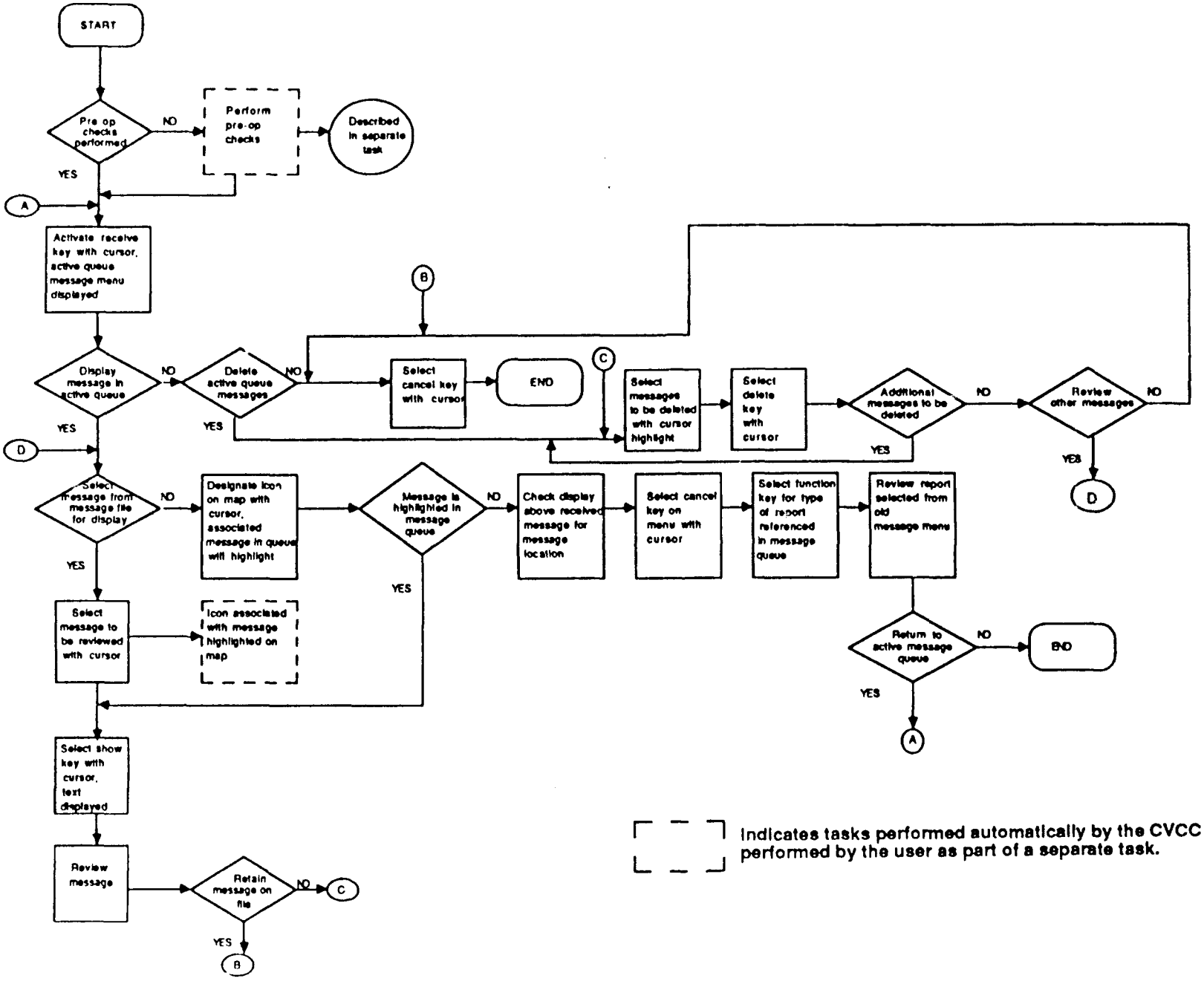
DISPLAYS
CCD Display

CONTROLS
CCd function keys

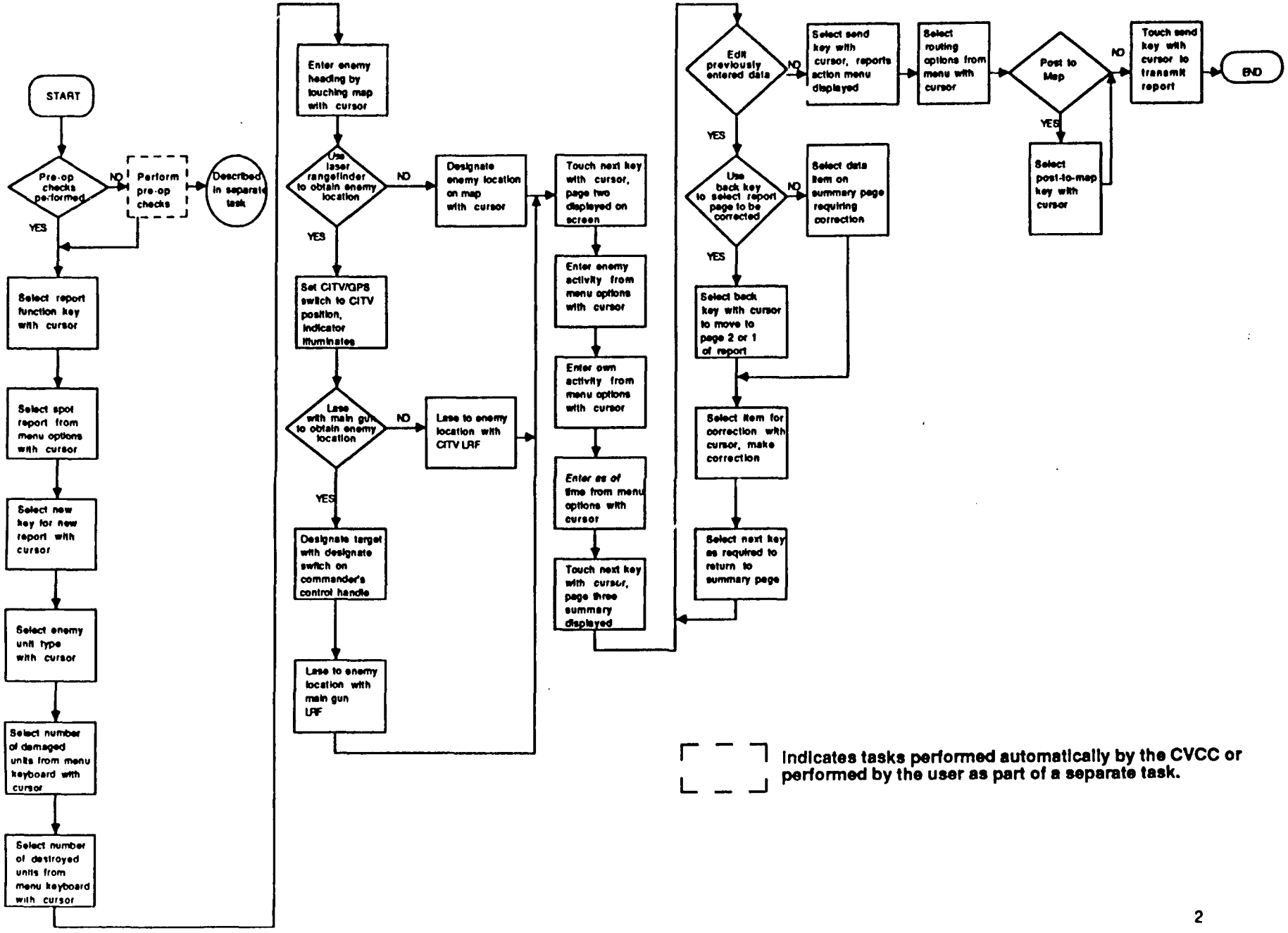
APPENDIX C

FLOW CHARTS

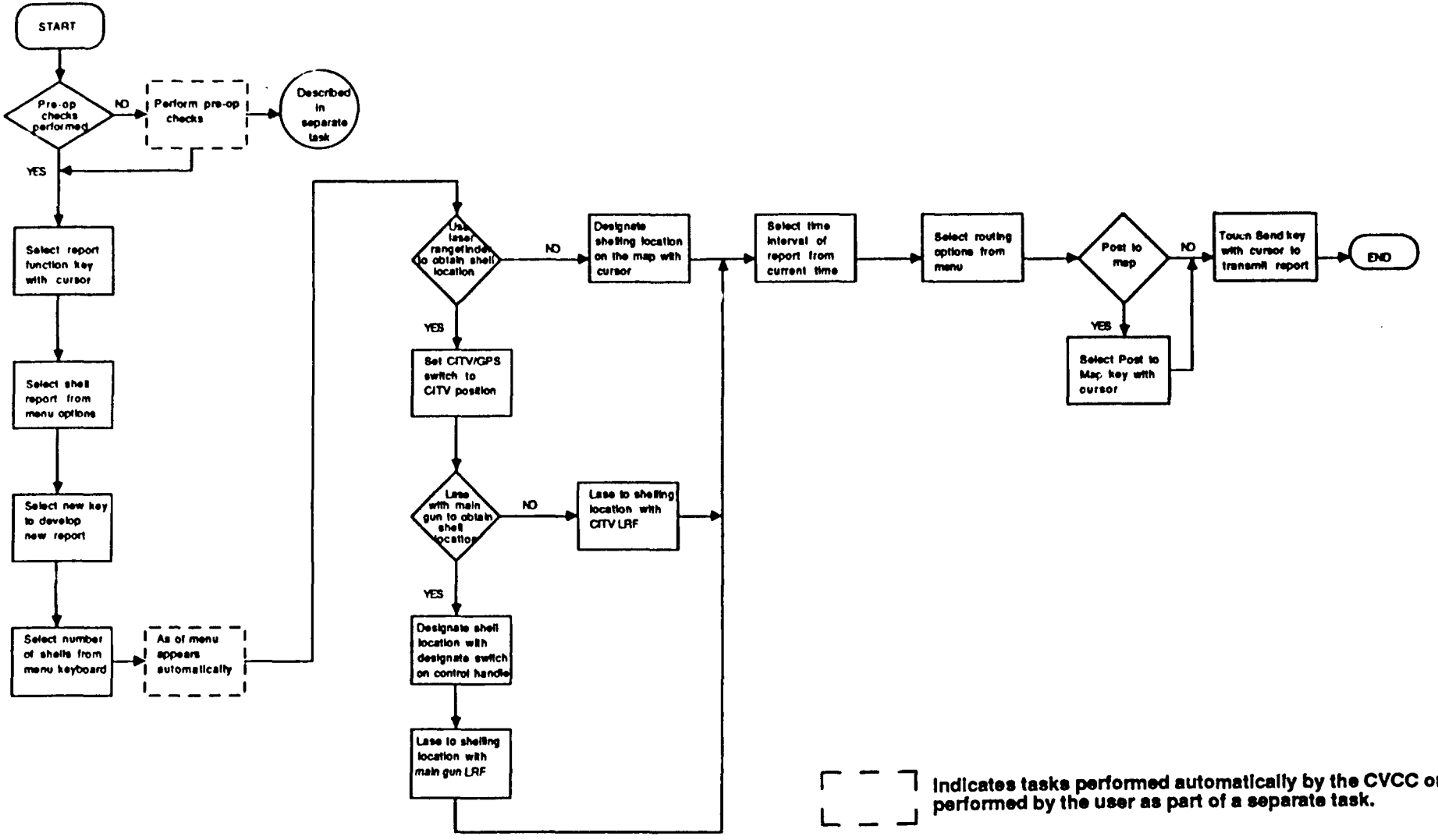
RECEIVE AND REVIEW REPORT USING CCD



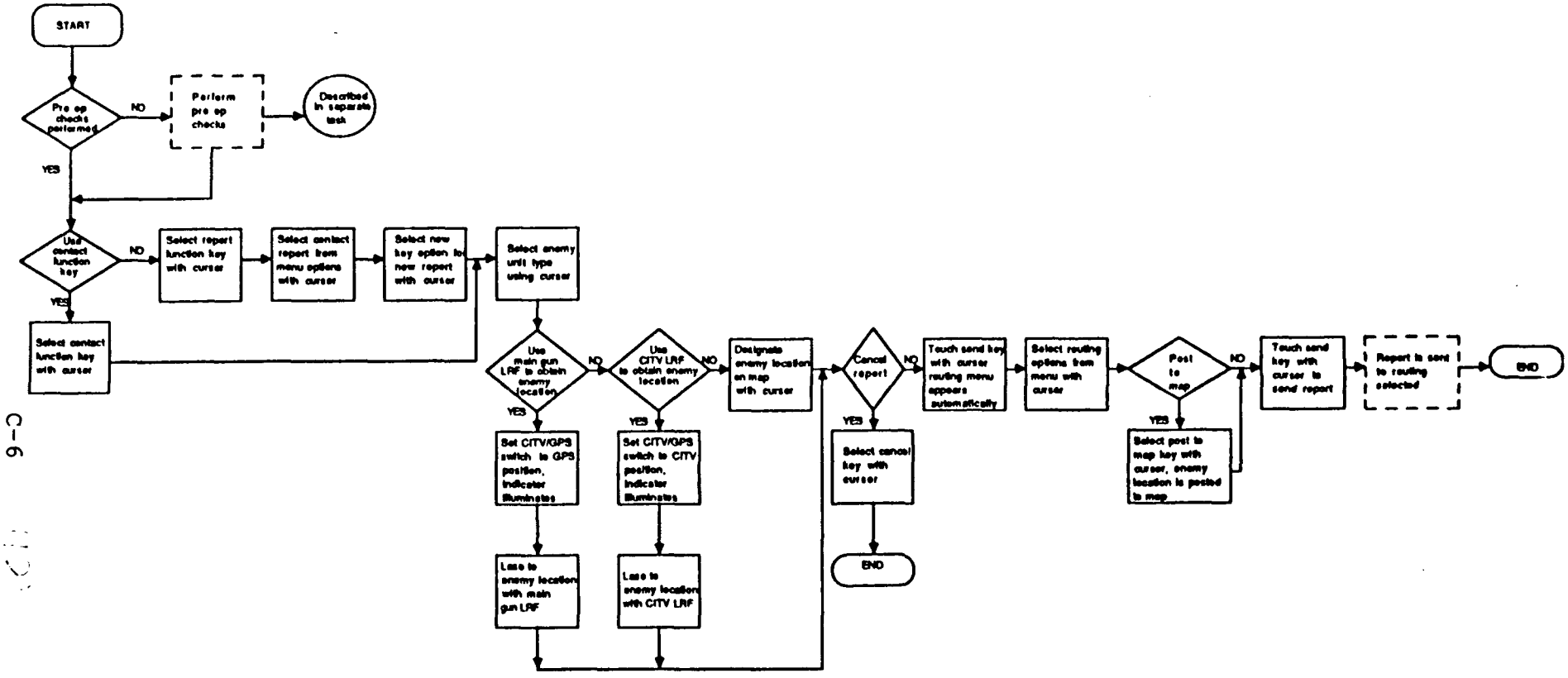
PREPARE AND SUBMIT SPOT REPORT USING CCD



PREPARE AND SUBMIT SHELL REPORT USING CCD

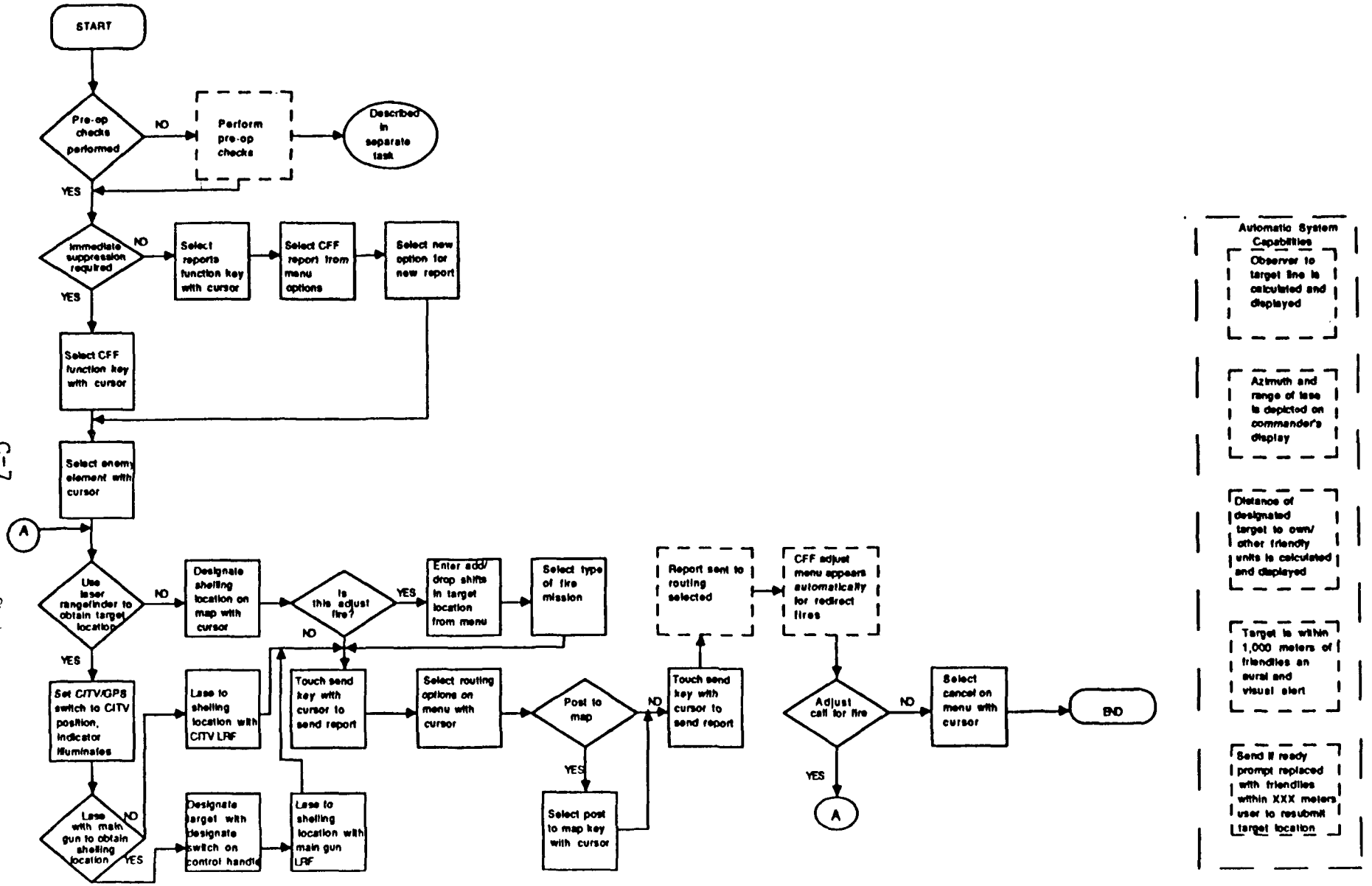


Indicates tasks performed automatically by the CVCC or performed by the user as part of a separate task.



Indicates tasks performed automatically by the CVCC or performed by the user as part of a separate task.

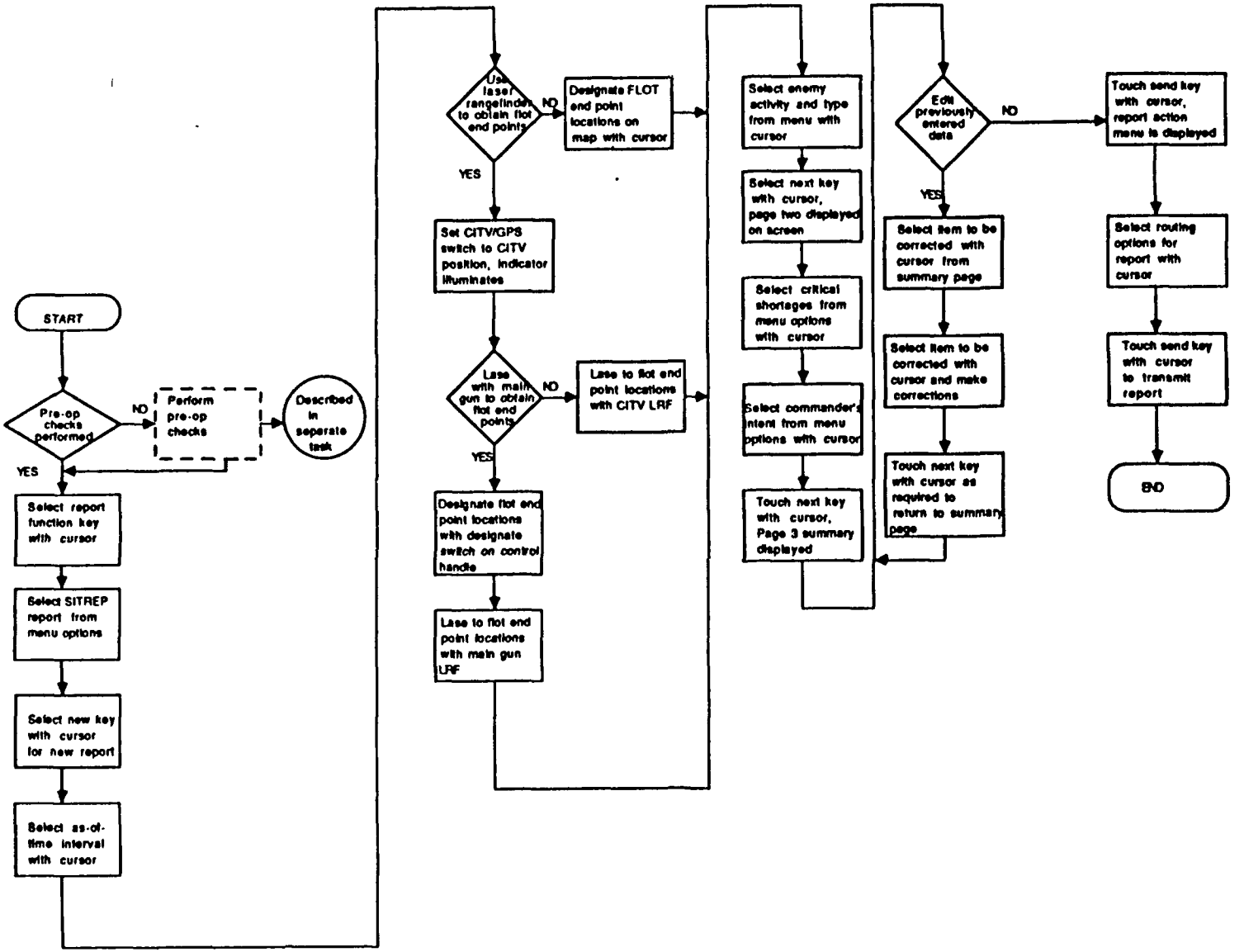
PREPARE AND SUBMIT CALL FOR FIRE REPORT USING CCD



C-7

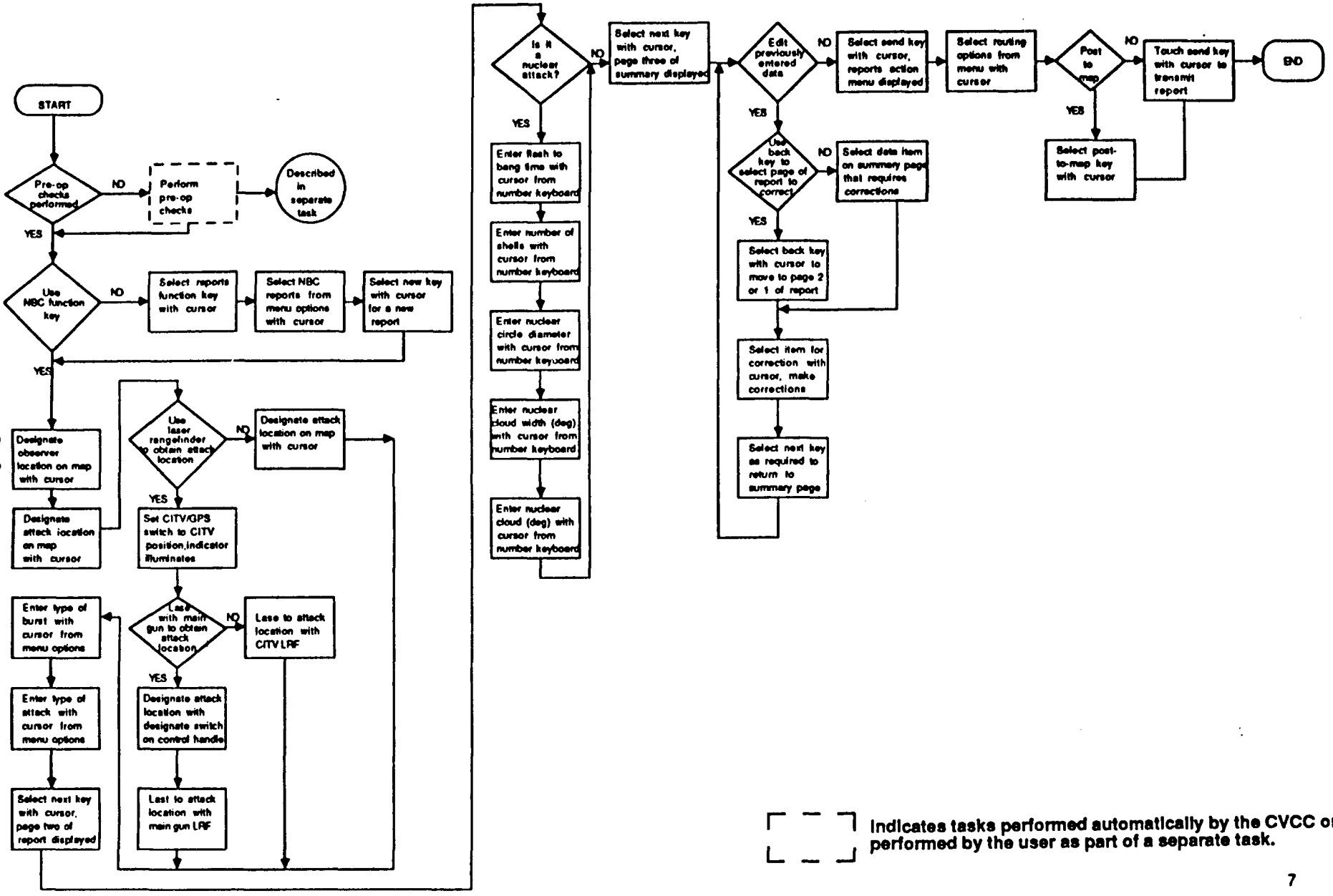
Indicates tasks performed automatically by the CVCC or performed by the user as part of a separate task.

PREPARE AND SUBMIT SITREP REPORT USING CCD



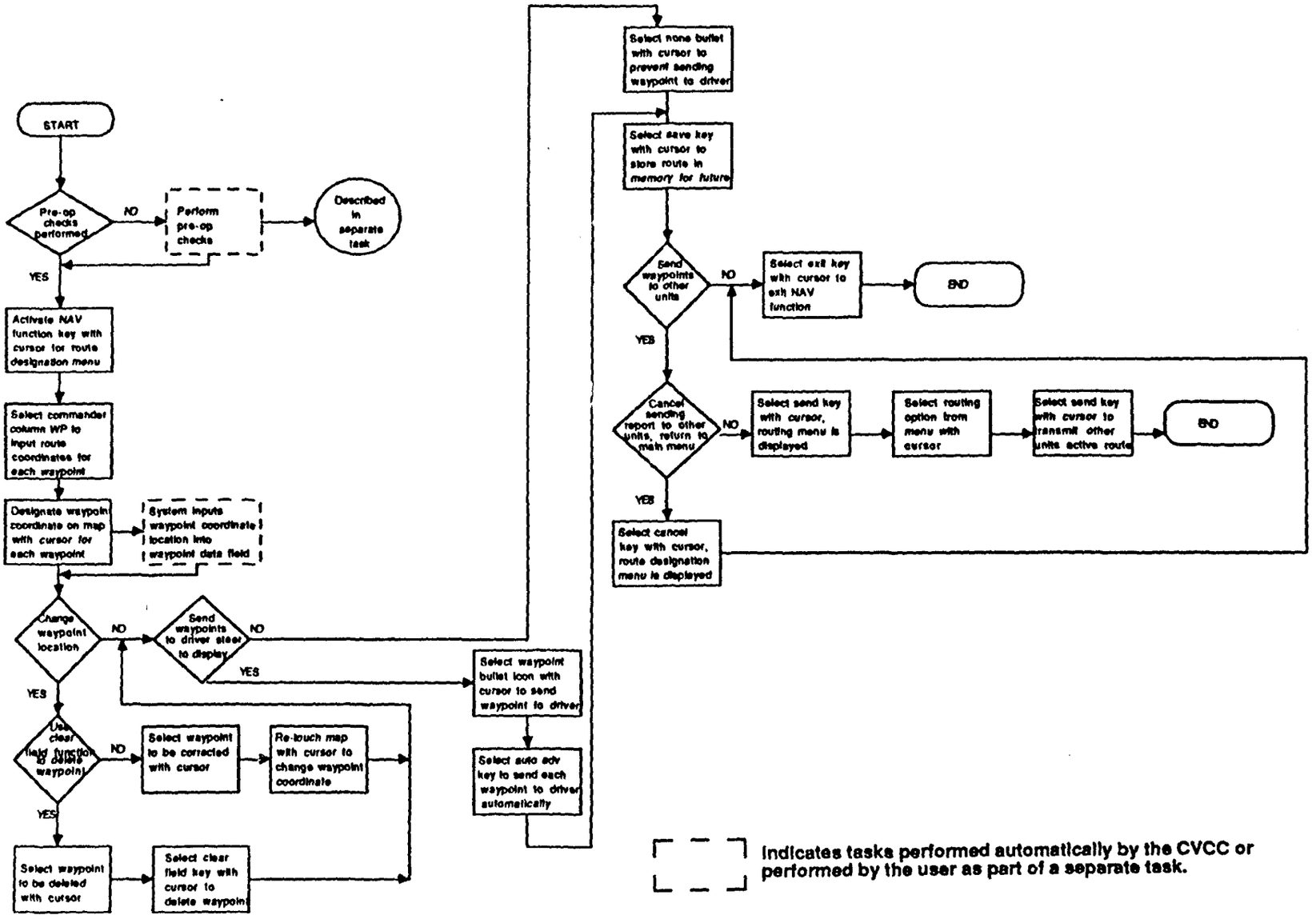
Indicates tasks performed automatically by the CVCC or performed by the user as part of a separate task.

PREPARE AND SUBMIT NBC REPORT USING CCD



Indicates tasks performed automatically by the CVCC or performed by the user as part of a separate task.

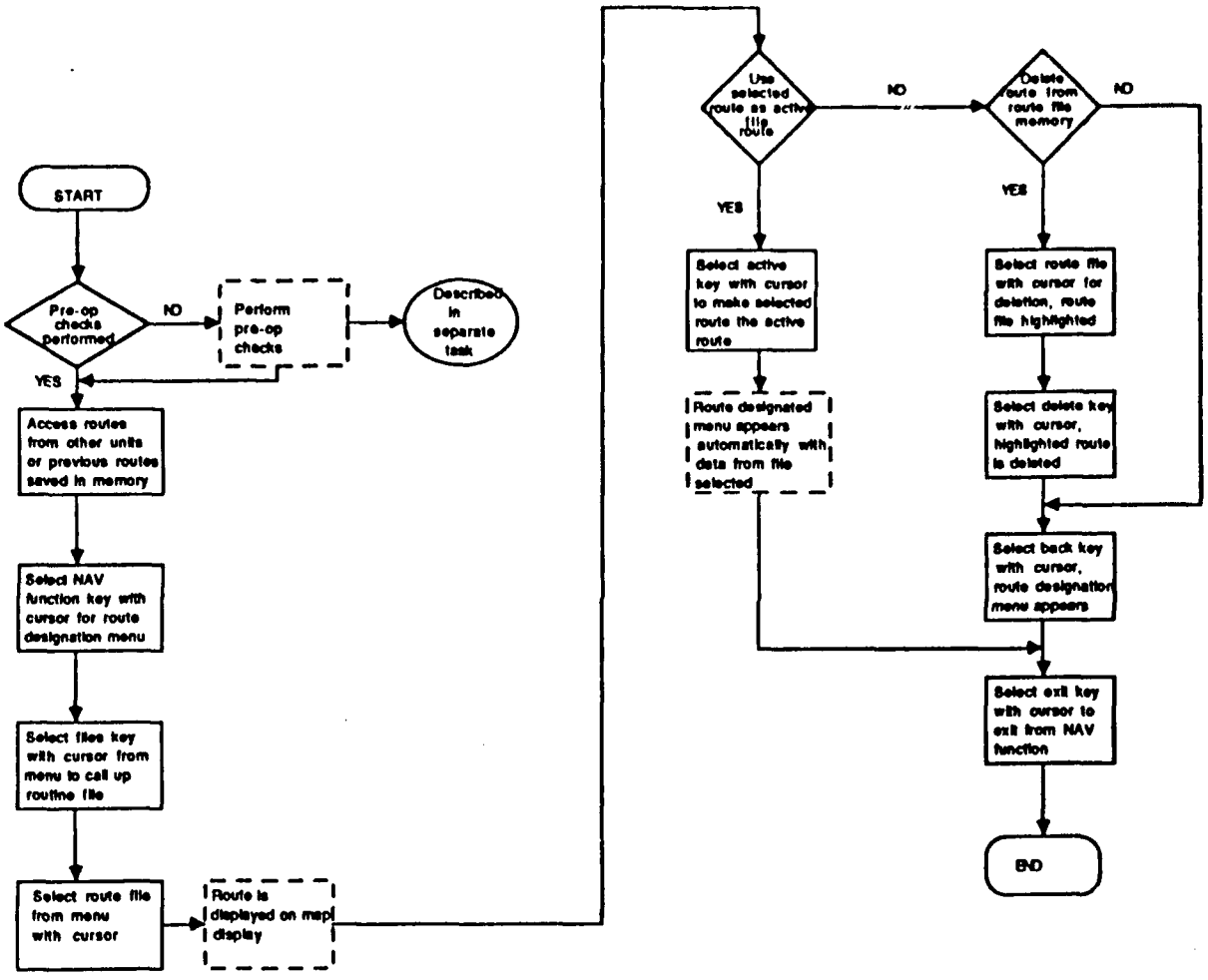
DESIGNATE AND TRANSMIT ROUTE COORDINATES USING CCD



C-10

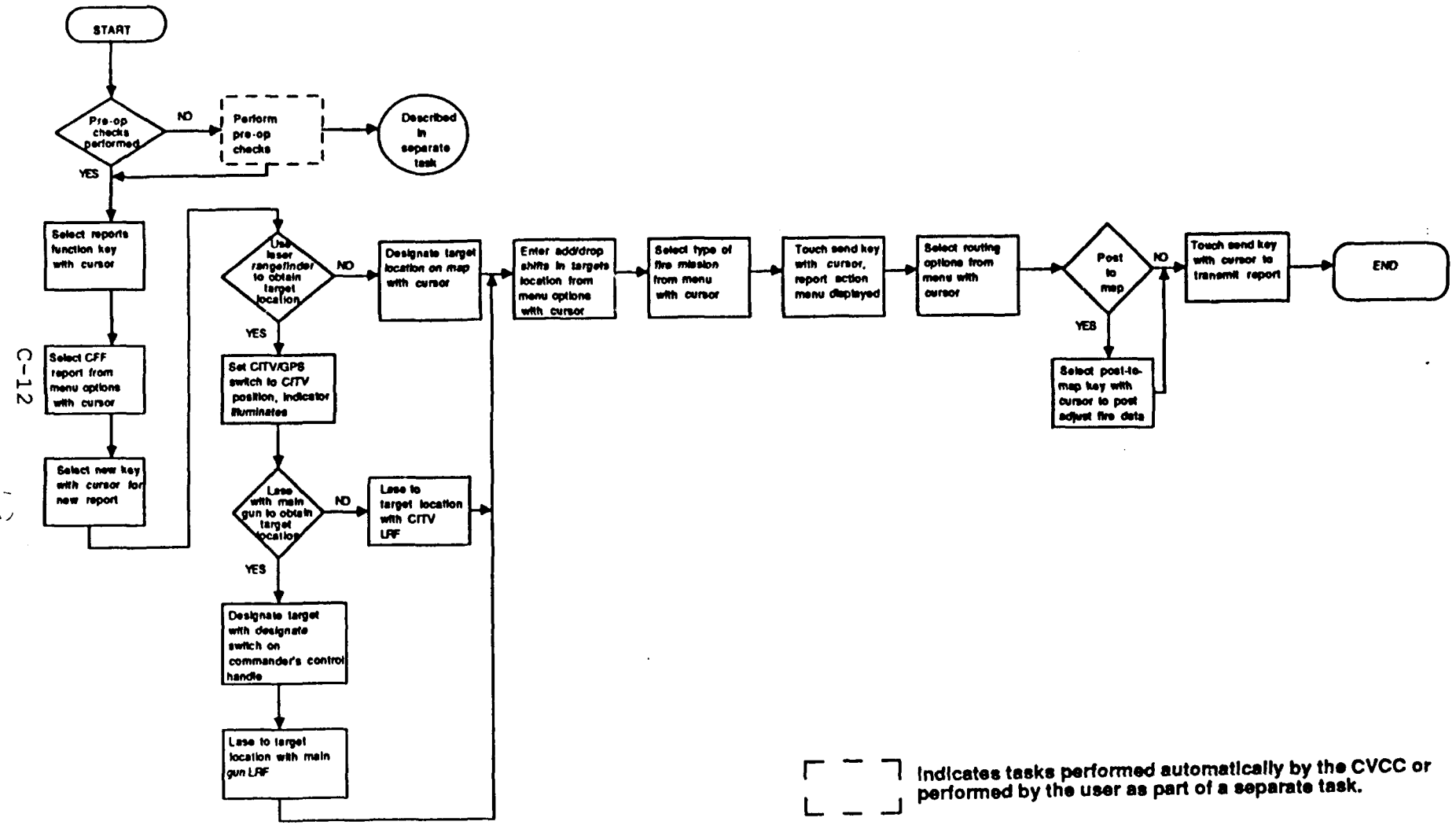
133

RECEIVE AND REVIEW ROUTE COORDINATES USING CCD



Indicates tasks performed automatically by the CVCC or performed by the user as part of a separate task.

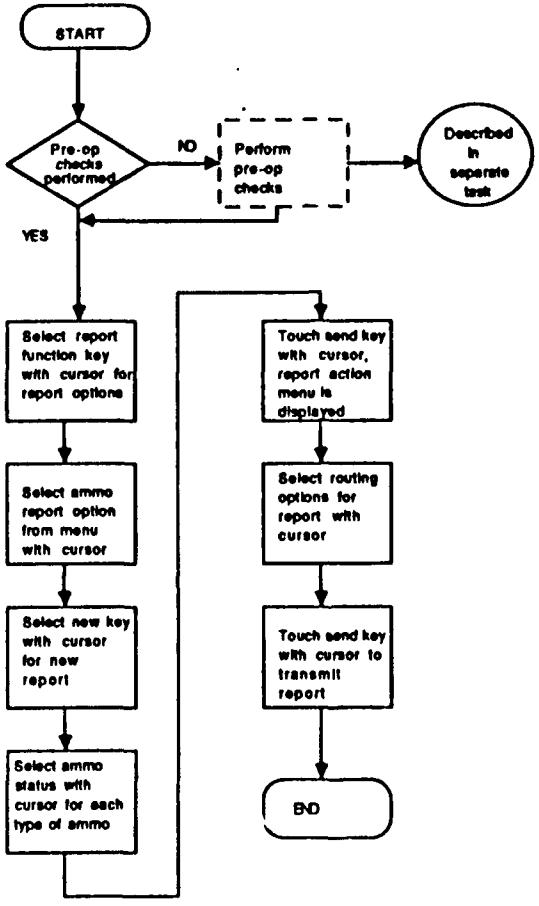
PREPARE AND SUBMIT ADJUST FIRE REPORT USING CCD



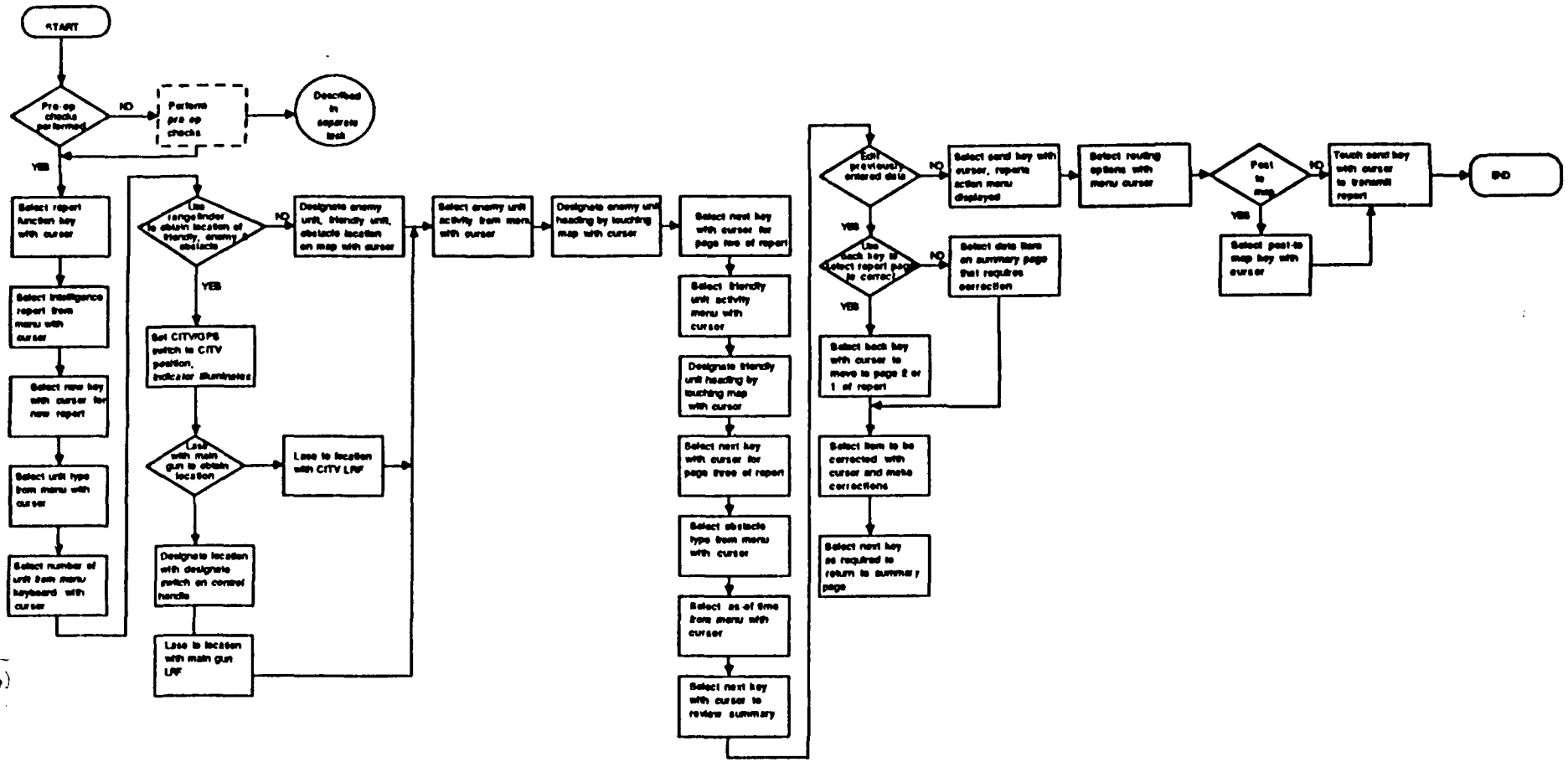
C-12

Indicates tasks performed automatically by the CVCC or performed by the user as part of a separate task.

PREPARE AND SUBMIT AMMO REPORT USING CCD



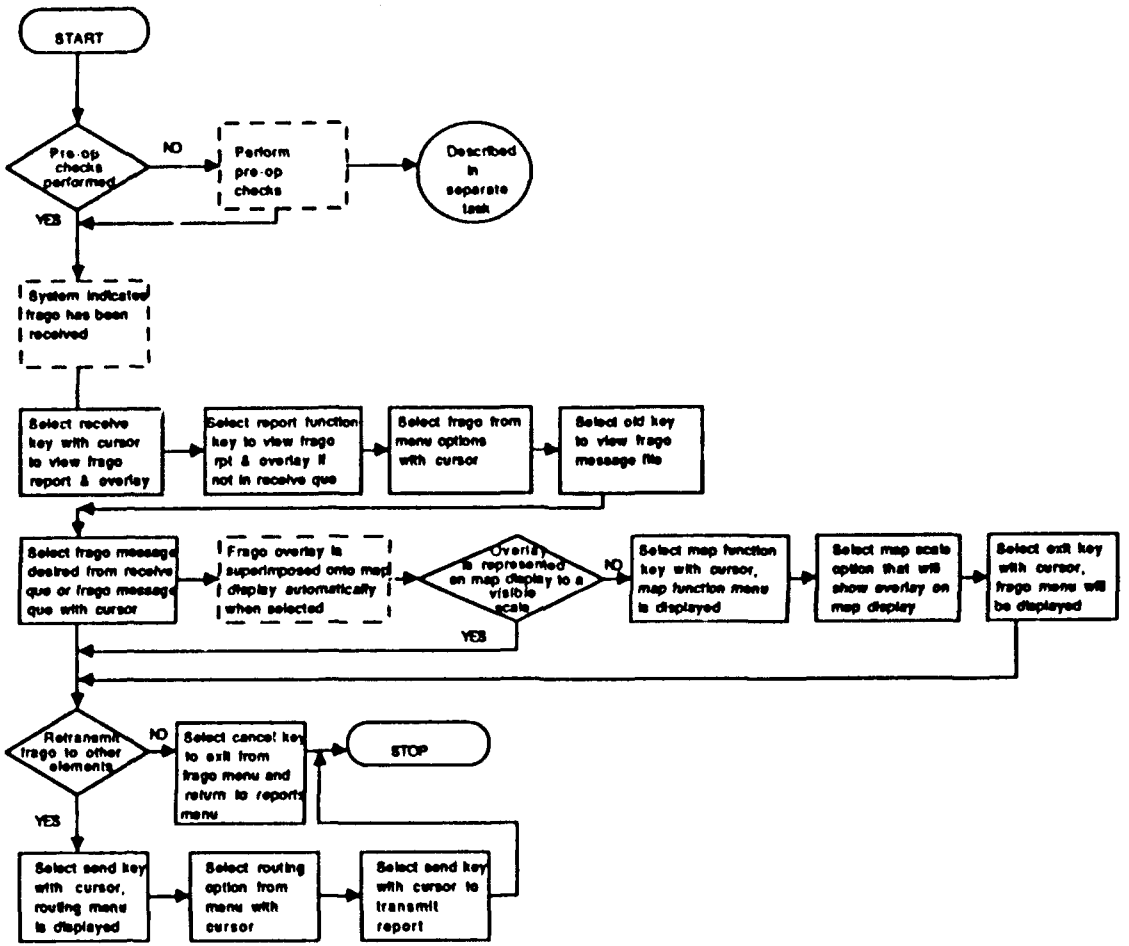
Indicates tasks performed automatically by the CVCC or performed by the user as part of a separate task.



C-14

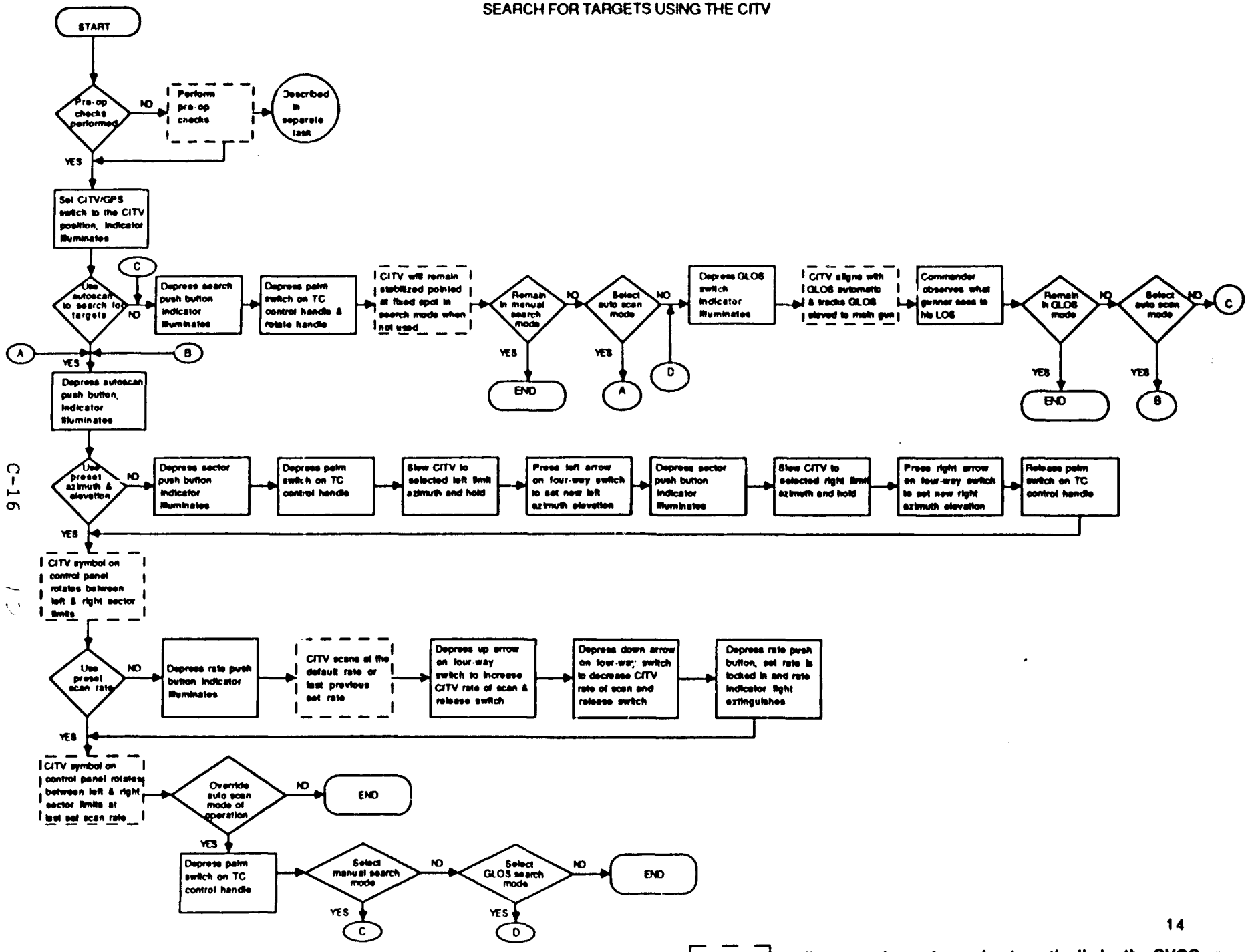
Indicates tasks performed automatically by the CVCC or performed by the user as part of a separate task.

RECEIVE, REVIEW AND RETRANSMIT FRAGO REPORT USING CCD



Indicates tasks performed automatically by the CVCC or performed by the user as part of a separate task.

SEARCH FOR TARGETS USING THE CITV

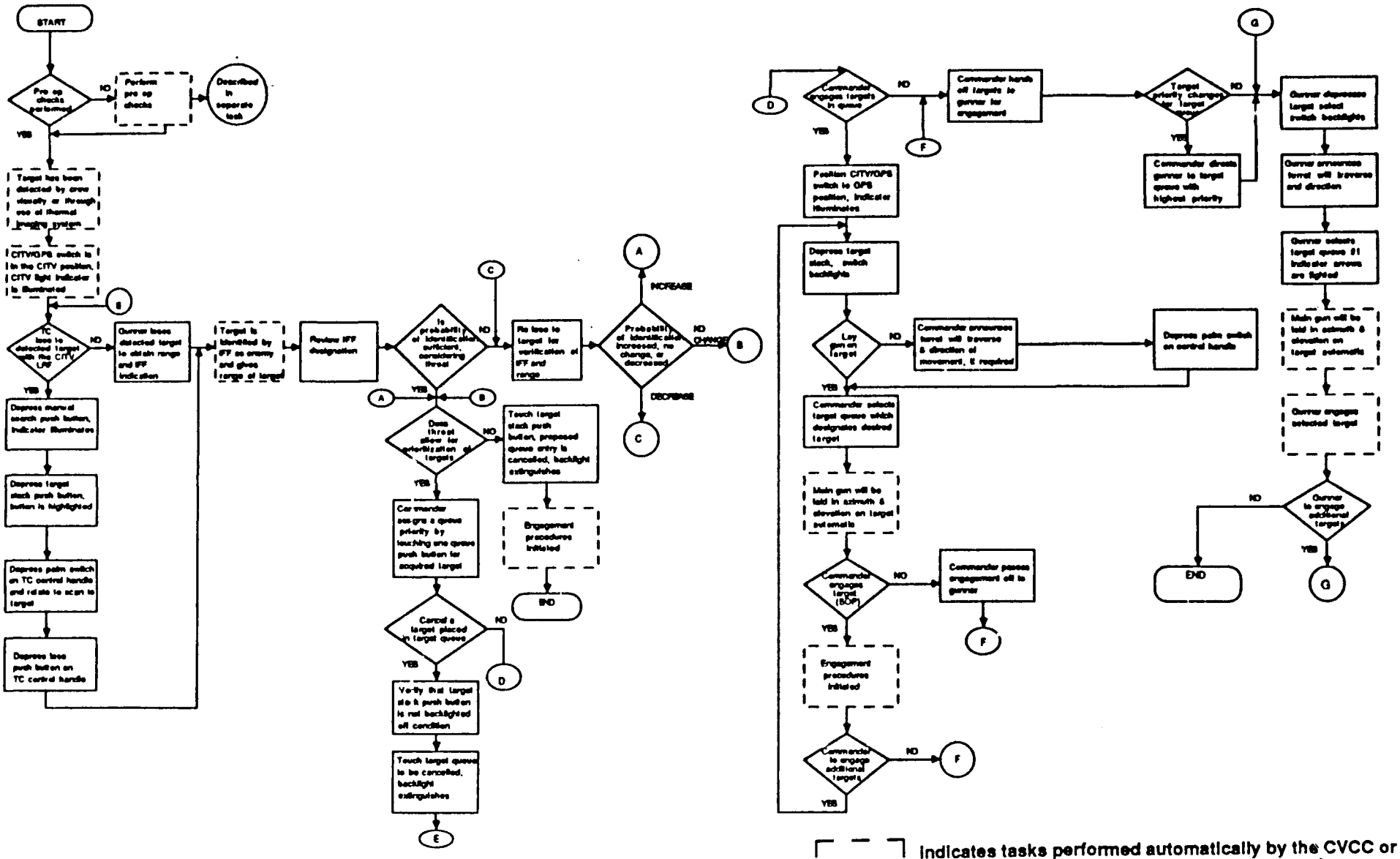


C-16

14

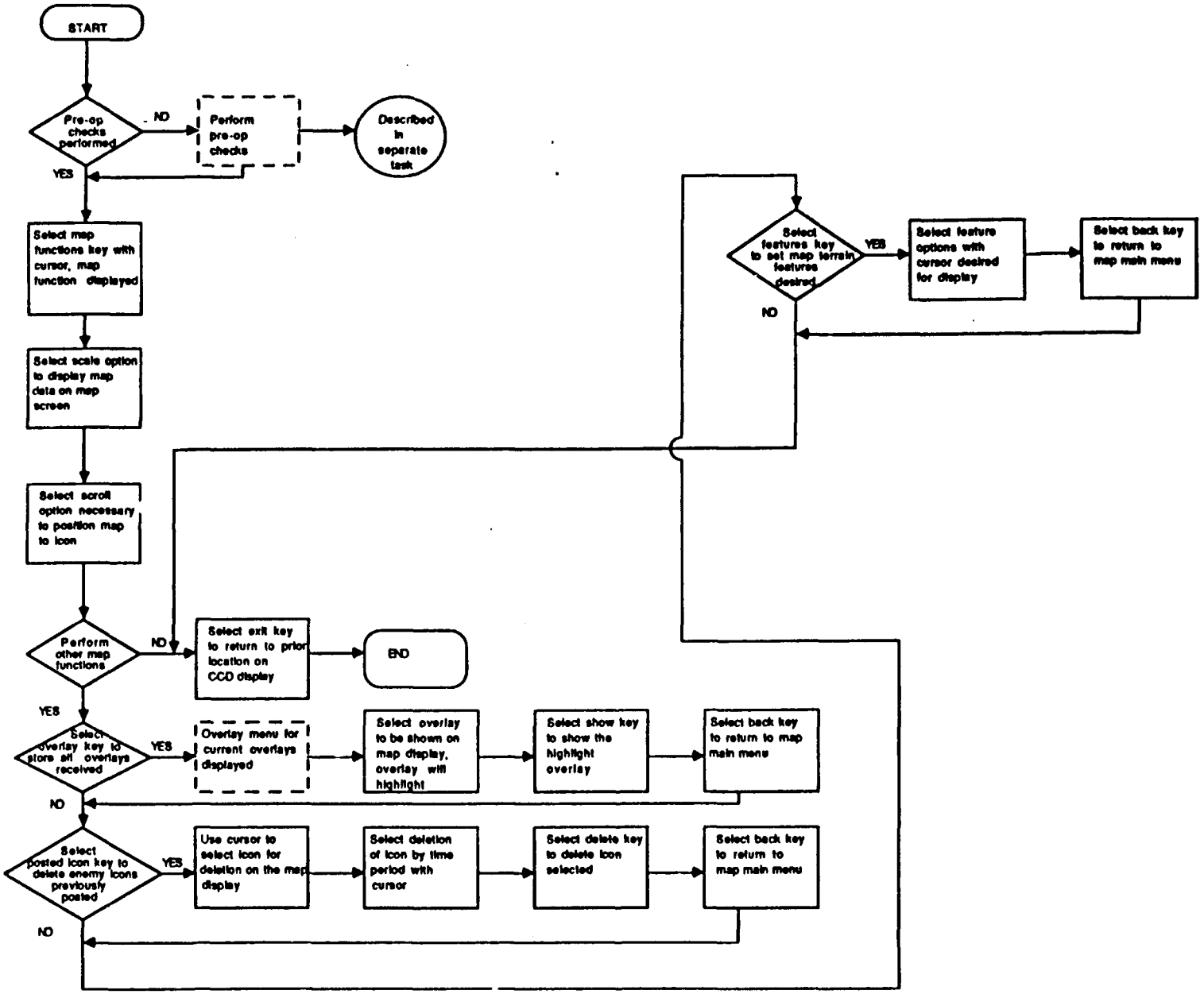
Indicates tasks performed automatically by the CVCC or performed by the user as part of a separate task.

IDENTIFY AND PRIORITIZE TARGETS USING THE CITV



Indicates tasks performed automatically by the CVCC or performed by the user as part of a separate task.

CONTROL MAP DISPLAY FUNCTIONS USING CCD



Indicates tasks performed automatically by the CVCC or performed by the user as part of a separate task.